2017 Chehalis ASRP
Stream-Associated Amphibian Survey Summary
Final Report for Post-Feasibility Baseline
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EXECUTIVE SUMMARY: ***Introduction***: The purpose of stream-associated amphibian surveys was to detect and determine the distribution of Dunn's and Van Dyke's salamanders (*Plethodon dunni* and *P. vandykei*) in the Chehalis headwater landscape in and around the footprint of the potential dam and reservoir. Dunn's and Van Dyke's salamanders are two of the key non-fish species representing the headwater stream-associated guild, one of the aquatic and semi-aquatic species guilds important in evaluating the potential effects of flood control alternatives on wildlife, and which informs the Chehalis Basin Aquatic Species Restoration Plan (ASRP). The portions of this effort conducted in 2014-2016 were also important to informing the PEIS and the Project-specific EIS. This report describes the entire effort, which extended from 2014 to 2017.

Methods**:** We randomly chose sites from a 187-site pool systematically placed along the stream network encompassing the footprint of the proposed dam and its reservoir and the surrounding area of coniferous forest landscape.

At each site, we used rubble-rouse surveys that involve a substrate search of nine 3 m × 5 m terrestrial plots spaced at 5-10 m intervals with their short axis abutting the wetted stream edge. Exceptions to this protocol were:

1) We used a light-touch survey of three 4 m × 12 m plots for the first two weeks (through 10 March 2014), but for detectability reasons, switched to the rubble-rouse method and more small plots; and

2) In 2017, we used light-touch surveys on the five locations where we found Van Dyke's salamanders in 2014-2015 to minimize the disturbance resulting from two previous survey years at those sites.

Sites where we resurveyed sites where we detected Van Dyke's salamanders in previous survey years to verify their continued presence. Light touch surveys involved overturning all movable surface objects up to 5 m upslope from wetted stream edges and along 50-100 m of shoreline.

Results**:** Over the 2014-2017 study period, our stream-associated amphibian surveys sampled 139 unique sites. Collectively, we made observations of 251 Dunn's salamanders at 55 unique sites (40%), and 181 observations of Van Dyke's salamanders at 14 unique sites (10%). For Dunn's salamander, this included 7 of 17 sites (41%) below, 25 of 65 sites (38%) within, and 23 of 57 sites (40%) above the proposed dam and reservoir footprint**.** For Van Dyke's salamander, this included zero of 17 sites below, 1 (2%) of 65 sites within, and 13 (23%) of 57 sites above the proposed dam and reservoir footprint. Breakdown by elevation revealed a sharper difference between the two

species. We found Dunn's salamander at 30 (40%) of 76 sites, 22 (51%) of 43 sites, and 3 (15%) of 20 sites, respectively, at ≤750 ft (229 m), 751 to 1500 ft (229 to 457 m) and >1500 ft (457 m). In contrast, we found Van Dyke's salamander at 1 (1%) of 76 sites, 7 of 43 (16%) sites, and 6 of 20 (30%) sites in the elevation categories. Subsequent-year repeat sampling of sites where we recorded Van Dyke's salamander found the species at 13 of the 14 sites; we did not detect Van Dyke's at one site where we found only one individual previously and riparian disturbance occurred at that site between sample years. Over the study period, we also made 1,851 incidental observations of at least 10 additional native amphibian species. Uncertainty about numbers of species arises from giant salamanders, which we did not genetically verify, but likely involves two species.

Conclusions: The study highlighted four patterns:

1) Van Dyke's salamander detection increases with elevation; as a result, Van Dyke's salamander is rare in the potential dam and reservoir footprint;
2) Dunn's salamander detection declines at the higher elevations;
3) Dunn's salamander seems common in the potential dam and reservoir footprint; and
4) the high diversity and numbers of amphibian species incidentally detected implies that the coniferous forest managed headwater landscape is amphibian rich.

The riparian habitat and life history needs of both salamanders, and the anticipated habitat changes of dam flood control alternatives lead us to conclude that:

1) the permanent reservoir of the FRFA design would eliminate existing habitat for both species, and re-establishment of either species along the "new" riparian margins of the potential FRFA dam/reservoir design is unlikely because of the dynamic stage variation of the reservoir and consequently, its dynamic effect on the riparian margin;
2) infrequent but uncertain inundation of the potential FRO dam design would eliminate existing habitat at irregular unpredictable intervals; and re-establishment of either species along the irregularly changing "new" riparian margins is unlikely;
3) the magnitude of habitat loss with either dam design would be much greater for Dunn's salamander than for Van Dyke's salamander because of the differential occurrence of Dunn's salamander at the lower elevations; and
4) either dam design may have uncertain isolating effects on both species because disruption of stream-margin connections among populations located in adjacent tributaries to the Chehalis mainstem is anticipated as the result of permanent (FRFA) or irregular (FRO) reservoir footprint positioning.

Next Steps: Under the monitoring plan that develops under the ASRP, either Dunn's and Van Dyke's salamanders might be choices for monitoring from among target species. A cool-adapted stenotherm that occurs at few sites, Van Dyke's salamander may be the most appropriate choice for monitoring if sensitivity to climate change is important and cost is a significant factor. Dunn's salamander would be an appropriate choice for monitoring if geographic tracking of longer-term response to climate change is important. The Science Review team will recommend the best options under which to use Dunn's and Van Dyke's salamanders for monitoring to the ASRP Steering Committee.

INTRODUCTION

This report summarizes and analyzes the results of the Chehalis ASRP stream-associated amphibian surveys through the balance of the study period (2014-2017) in headwaters of the Chehalis mainstem that encompasses the vicinity of the proposed footprint of the dam and its reservoir and the adjacent headwater areas. These surveys focus on the terrestrial stream-associated amphibians[1] because Dunn's salamander (*Plethodon dunni*) and Van Dyke's salamander (*P. vandykei*), two of the eight ASRP non-fish aquatic-habitat associated target species, are regarded as stream-associated but occur in the terrestrial riparian habitat immediately adjacent streams. These surveys were initiated on 24 February 2014, were always conducted during the post-winter thaw interval when substrate moisture was adequate for near-surface activity, and ultimately completed for baseline work on 15 June 2017. Several years are required to complete an adequate assessment because the time window in which these species (particularly Van Dyke's salamander) are surface active (that is, effectively detectable) in any one year is relatively short (its 3-4-month length is somewhat unpredictable)[2], which limits the number of sites that can be surveyed annually.

METHODS

SITE SELECTION: We chose sites from a 201-site pool systematically placed along the stream network within the coniferous forest landscape to provide an array dispersed across the footprint of the proposed dam and its reservoir[3] and the greater surrounding area. Besides the fact that this footprint encompasses the proposed dam and reservoir area, this footprint was selected based on the coniferous forest landscape being the only Chehalis River mainstem headwaters habitat where Van Dyke's salamander might be expected. Except for a portion of the South Fork Chehalis River headwaters, this footprint is the only part of the Chehalis Basin where Dunn's salamander is present. We selected sites in this pool to be at least 400 m (1,312 ft) from one another to ensure independence among sites.[4]

We developed an original pool of 128 sites in 2014 from which to select sites, but increased that pool by 15 new sites later in 2014, by 43 new sites in 2015, by one site in 2016, and by 14 new sites in 2017. One reason for augmenting the site pool was our inability to access selected sites because of washed out roads or because selected sites lacked habitat for sampling (e.g., a bedrock cliff face) or had too little habitat to lay out a sampling array (see Sampling section). This reason led us to reject five sites in 2014, nine sites in 2015, and 25 sites in 2016. The second reason for adding to the site pool was to enable selecting enough sites outside the potential dam and reservoir footprint to understand potentially different patterns of distribution within versus

[1] Four additional species of instream-breeding amphibians reproduce in small (3rd-order or less) streams in the Chehalis River mainstem headwaters, but these are the focus of surveys for the upcoming biennium.

[2] Unpredictability reflects inter-year variability in substrate moisture, largely a function of precipitation patterns.

[3] When we discuss the footprint of the proposed dam and reservoir, footprint means the reservoir at full pool.

[4] This selection distance ensured independence because the annual movement scale of terrestrial salamanders, like Dunn's and Van Dyke's salamanders, is <20 m (Ovaska 1988, Staub et al. 1995).

outside of that footprint. We considered the latter critical to characterizing the consequence of potential changes in habitat resulting from the location of a proposed dam/reservoir footprint.

We had a target minimum number of sites to be sampled each year based on our effective sampling window and field crew size. Our minimum target number of sites was 30 in each year of the 2015-2017 interval, and 51 in 2014 (**Table 1**). The greater target number in 2014 was because we had a field crew that we could devote exclusively to this sampling and we sampled well beyond the recommended survey interval for Van Dyke's salamander to verify the protocol based on the temperature limits Jones (1999) provided. In contrast in 2015-2017, we partitioned crew effort between stream-associated amphibian sampling and other Chehalis tasks.

Table 1. Target site numbers, numbers of sites actually sampled and their distribution relative to the potential dam/reservoir footprint and Van Dyke's sites resurveyed by year. Unique means the total number of different sites summed across all years. Sampled means the total number of sites sampled including sites that were repeat-sampled.

	Survey	Site Numbers		Location per Footprint			Resampled PLVA sites		
Year	Interval	Target	Sampled	Below	Within	Above	2014	2015	2016
2014	Feb 24-Jul 31	51	58	4	34	20	-	-	-
2015	Mar 18-Apr 29	30	30	3	16	11	2	-	-
2016	Mar 6-May 5	30	37	4	17	16	2	3	-
2017	Mar 30-Jun 15	30	30	6	1	23	2	3	4
		Sampled	155	17	68	70			
		Unique	139	17	65	57			

Our objective was to canvass the proposed dam and reservoir footprint and surrounding area as thoroughly as possible to understand the stream-associated lungless salamander distribution, so our selection pattern shifted somewhat between years. In 2014, we selected sites to be sampled so that about 60% (n = 31) of the sites were from within the proposed dam/reservoir footprint; the remaining about 40% of the sites were selected from above (n = 18) and below (n = 2) the dam/reservoir footprint in a ratio of 9:1 above versus below the reservoir (**Table 1**). In 2015 and 2016, we created the target of 14 sites to be sampled outside of the footprint that were selected in a ratio 11:3 above versus below and 16 within (**Table 1**). We designed this selection pattern to capture potential differences in species distribution that might occur as a consequence of footprint location when considering the large area of coniferous forest habitat available upstream, which, in some ways, is similar to existing habitat within the footprint. In contrast, coniferous forest habitat was very limited downstream of the footprint. In 2017, we shifted the ratio to capture higher elevation sites to enable an effective elevational comparison, resulting in one within, 23 above, and six below the potential dam/reservoir footprint (**Table 1**). In every year after the initial survey year (2014), we resampled all the sites where Van Dyke's salamanders had been found collectively over all previous years (**Table 1**) to assess whether the species was still present at those sites. **Figure 1** shows the distribution of both sites available for sampling across all years, and sites that had to rejected for some reason.

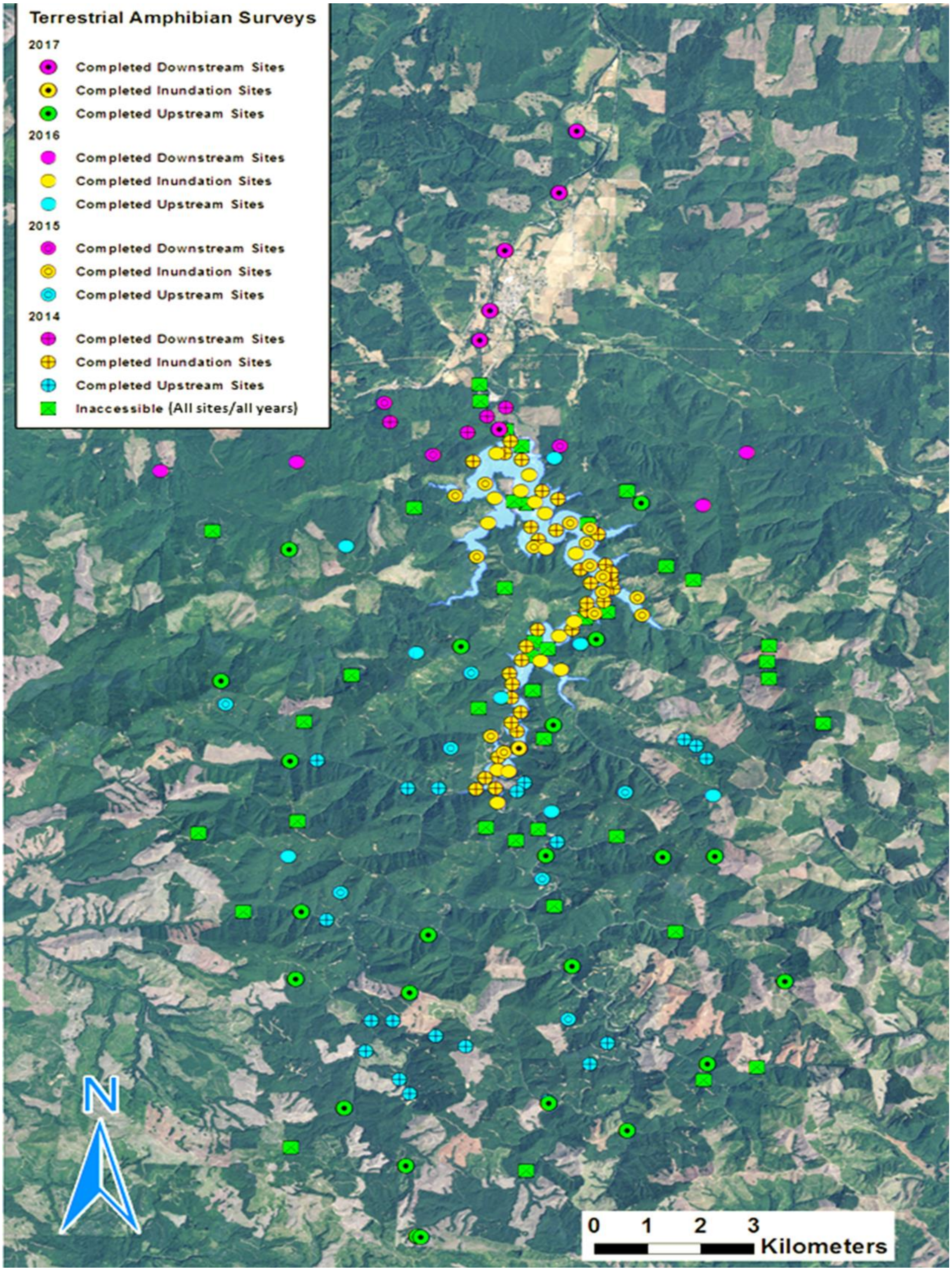
SAMPLING: We used a light-touch survey of three 4 m × 12 m plots for the first two weeks (through 10 March 2014), but for detectability reasons, switched to the rubble-rouse method and more small plots. Thereafter, we conducted all surveys with a field crew of at least three with sampling done on four days each week (Monday-Thursday schedule). We surveyed by laying out nine 3 m wide × 5 m long plots at each site, each of which abutted the wetted edge of the stream along their short axis. Sampling was done by raking through the litter (leaves, conifer needles, and small wood debris), rock and soil substrate with a potato rake, overturning movable surface objects, and taking apart woody debris sufficiently decayed to be dismantled. The only other exception to the sampling protocol was done in 2017, where we conducted light-touch surveys on the five Van Dyke's salamander locations from 2014 and 2015. These light touch surveys involved moving all movable surface objects up to 5 m upslope from wetted stream edges and along 50-100 m of shoreline. We used this method to minimize the repeated disturbance resulting from multiple years of surveys at those sites (**Table 1**).

RESULTS

Over the four-year study interval, we exceeded our planned 125-site target with 139 unique sites surveyed (**Table 1**). Seventeen unique sites were located below the inundation footprint of the potential dam/reservoir (magenta circles in **Figure 1**), 65 unique sites were located within the footprint (gold circles in **Figure 1**), and 57 unique sites were located upstream of the footprint (green circles in **Figure 1**). We rejected another 22 sites for accessibility, safety or sampling habitat reasons (green squares in **Figure 1**).[5] Forty additional sites existed in the overall sampling pool that were not selected; these are not shown. When sites were repartitioned by elevation, 76 unique sites were ≤750 ft (229 m), 43 unique sites were 751-1,500 ft (229-457 m), and 20 unique sites were >1,500 ft (457 m).

[5] Selected sites were inaccessible in some years because of timber harvest road closures, and some sites had risky slope conditions or lack habitat (vertical cliff) that could be sampled.

Figure 1. Stream-associated amphibian survey site locations by year. Color coding indicates whether sites were downstream (completed downstream sites), within (completed inundation sites) or above the proposed dam and reservoir footprint (completed upstream inundation sites). Symbols in the colored circles match sample years. Inaccessible sites shown in green squares.



Over the study period, we recorded observations of 1,849 individuals representing at least 12 species[6] of amphibians at all sites surveyed. We recorded 1,824 of these individuals at 127 of the 139 sites surveyed, and the remaining 19 individuals at twelve incidental locations.[7] The four species of terrestrial salamanders represented 73.4% (n = 1,358) of all observations; at least eight species of non-terrestrial amphibians were the remaining 26.6% (n = 491) of observations. We also viewed that latter as incidental because they were not the survey focus.

Based on rubble-rouse surveys, the Western red-backed salamander was the most frequently recorded amphibian and the most frequently encountered terrestrial salamander in every study year. In particular, the Western red-backed salamander annually had the highest percentage of total observations of lungless salamanders ($\bar{x}$ = 66.2%: 61.5-78.2%), and was encountered at the highest percentage of surveyed sites ($\bar{x}$ = 79.8%: 62.7-89.2%). Western red-backed salamanders also ranked highest in the mean number of individuals per occupied site ($\bar{x}$ = 7.2 individuals/occupied site: 5.7-8.9 individuals/occupied site).

Dunn's salamander was the second to the Western red-backed salamander in many categories based on the same survey set. In particular, Dunn's salamander was second highest annually in percentage of total observations of lungless salamanders ($\bar{x}$ = 18.3%: 9.8-23.6%), was second highest found in percentage of sites surveyed ($\bar{x}$ = 44.0%: 25.5-52.0%), but was third highest in mean number of individuals per occupied site ($\bar{x}$ = 3.8 individuals/occupied site: 1.8-4.7 individuals/occupied site).

Van Dyke's salamander and Ensatina were generally the least often recorded lungless salamander species based on the same surveys. Van Dyke's salamander was recorded at the second lowest mean percentage of surveyed sites ($\bar{x}$ = 19.2%: 3.9-32.0%) and, the mean percentage of surveyed sites for Ensatina was only slightly lower ($\bar{x}$ = 18.1%: 0.0-27.0%). Of lungless salamander observations Van Dyke's salamander and Ensatina represented respectively, ($\bar{x}$ = 11.8%: 5.1-20.0%) and ($\bar{x}$ = 3.7%: 0.0-6.8%). However, Van Dyke's salamander ranked second among lungless salamanders in the number of individuals per occupied site ($\bar{x}$ = 6.1 individuals/occupied site: 4.9-7.5 individuals/occupied site), but we recorded the lowest number of individuals per occupied site for Ensatina ($\bar{x}$ = 1.5 individuals/occupied site: 1.2-1.8 individuals/occupied site). Van Dyke's salamanders were re-countered at both sites in 2015 where they were found in 2014, at all seven sites in 2016 where they were found in 2014 and 2015, and at eight of the nine sites in 2017 where they were recorded during the 2014-2016 seasons. The only site in 2017 were Van Dyke's salamander was not found where it had been recorded in previous years was one of four sites in the total study where only a single individual had been found; additionally new and active road construction during 2017 immediately adjacent to the site necessitated shifting the study plots upslope approximately 100 m The five new sites

[6] Uncertainty about the number of species is because the species identity of giant salamanders was not genetically verified; two species are possible: Cope's giant salamander (*Dicamptodon copei*) and Coastal giant salamander (*D. tenebrosus*).

[7] Incidental locations were locations that were examined, but rejected for sampling at which at least one amphibian was found.

at which Van Dyke's salamander was found in 2017 brought the total unique sites where Van Dyke's salamander was found during the overall study to 14.

Dunn's and Van Dyke's salamanders are also differentially distributed relative to the location of the proposed dam/reservoir footprint. Based on location relative to the footprint across all years, we found no Van Dyke's salamanders below the footprint (17 unique sites sampled) and at only one site within the footprint (2% of 65 unique sites sampled); all remaining Van Dyke's salamander locations (n = 13) were above the footprint, which represented 23% of the 57 unique sites sampled (**Figure 2**). Exact testing across the three regions relative to the footprint revealed that the proportion of Van Dyke's salamander present differed significantly among regions ($p = 0.0009$). The difference in the proportion of sites with Van Dyke's salamander below footprint versus within the footprint (0.0154) was not significant ($p = 0.6037$); the upper and lower confidence limits of that difference included zero (**Table 2**). In contrast, the difference in the proportion of Van Dyke's sites below versus above the footprint (-0.2281) and within versus above the footprint (-0.2127) were both significant ($p = 0.0195$ for the former and $p = 0.0002$ for the latter); the confidence limits of each excluded zero (**Table 2**). In contrast, Dunn's salamander was distributed at similarly below, within and above the footprint, the proportions covering a narrow range (0.3846-4118; $p = 0.9555$ for the overall comparison). The confidence limits around the difference in each proportion pair for all three comparisons encompassed zero (**Table 2**).

Partitioning by 750-ft elevation blocks showed a somewhat different pattern. In this case, the proportion of sites where Dunn's salamander was found did not differ significantly across the three elevation blocks ($p = 0.3387$ for the overall comparison; **Figure 3**). Post hoc contrasts were unnecessary, but run to verify the result. The confidence limits around the differences between all three elevation block combinations encompassed zero (**Table 2**), indicating lack of significance. In contrast, overall comparison in the proportion of sites across elevation blocks was significant for Van Dyke's salamander ($p = 0.0002$). Post hoc comparison showed that the proportion of Van Dyke's salamanders specifically differed between the low- and each of the mid- and high-elevation blocks (Low versus Mid: $p = 0.0031$; Low versus High: $p = 0.0003$), but did not differ between the mid- and high-elevation blocks ($p = 0.1193$). The confidence limits excluded zero in the former two cases, but not in the latter case (**Table 2**).

The four years over which we surveyed for lungless salamanders across the Chehalis River mainstem headwaters varied greatly in precipitation, and as a consequence, seasonal moisture levels. The station recording the most proximate climatic data, the Doty gauge (**Table 3**) reveals substantial differences in precipitation among the four Water Years and the three-month moving averages preceding the months we surveyed in each year. These data reveal that the 2013-2014 and 2014-2015 Water Years were drier by roughly 20 inches of rainfall than the Water Years 2015-2016 and 2016-2017.

Figure 2. Distribution of Dunn's and Van Dyke's salamanders relative to the footprint of the proposed dam and reservoir. Number of unique sites sampled in each location category across all years combined (2014-2017) are indicated below category labels. Data shown is the mean proportion of sites with each species and its upper and lower 95% confidence limits. The values for the proportions and 95% confidence limits are in Appendix Table 5.

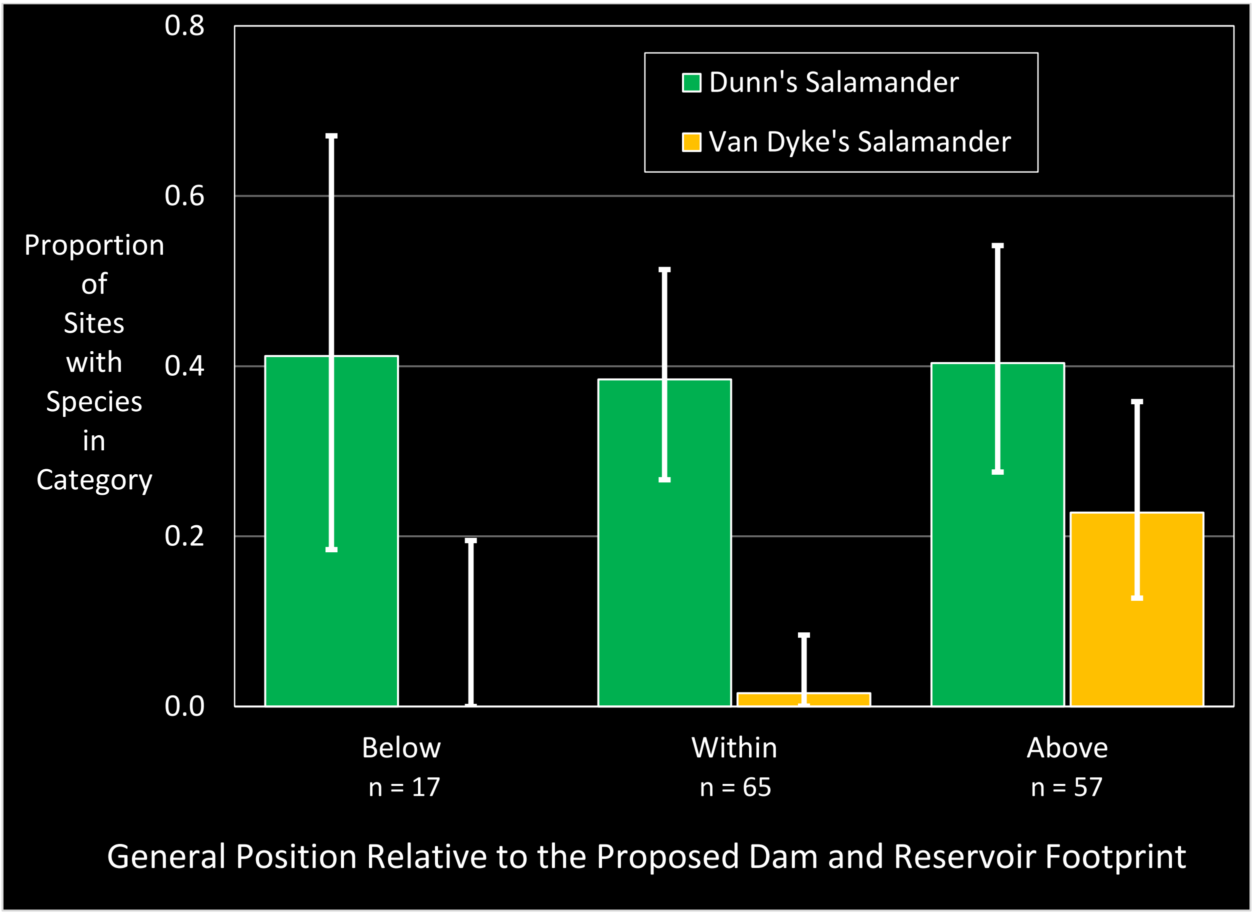
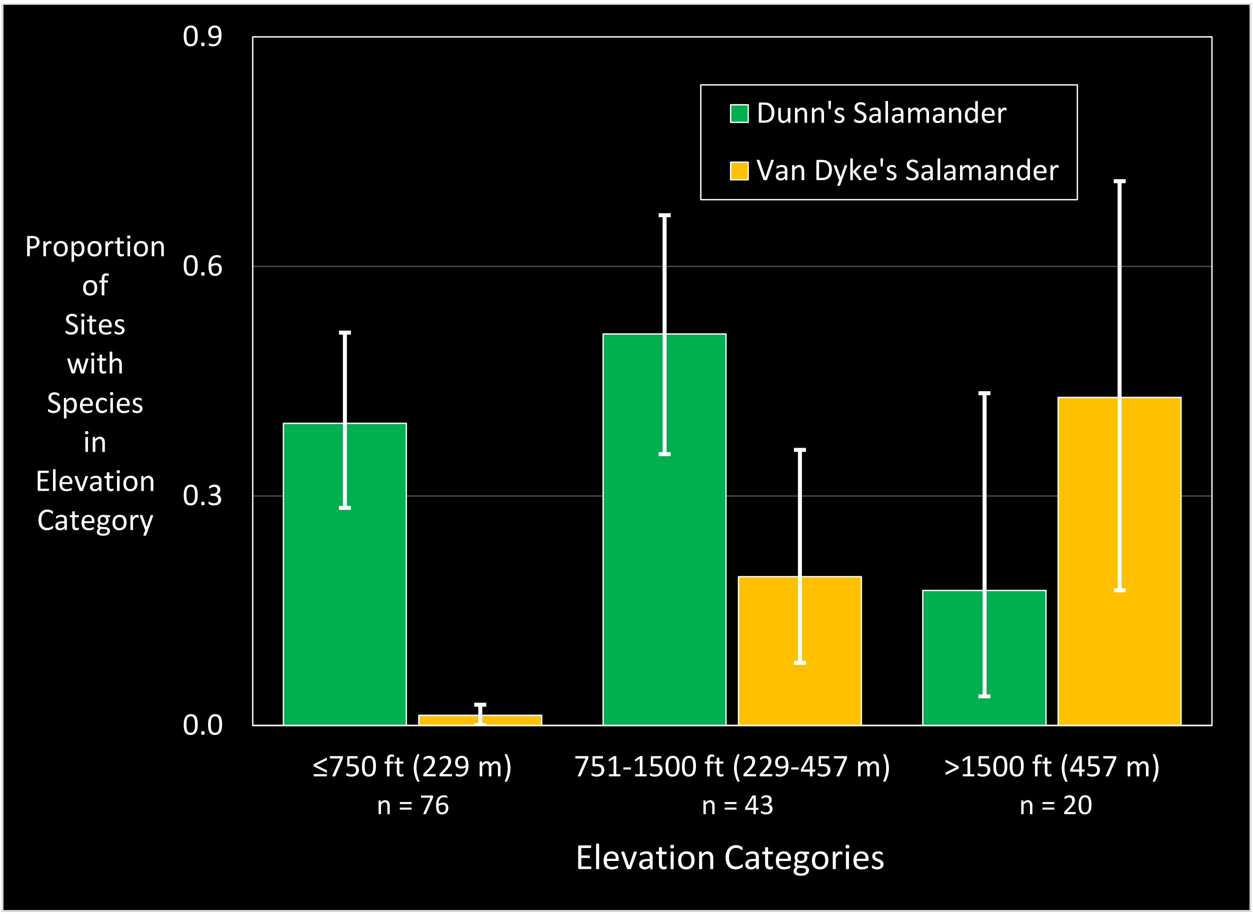


Table 2. Contrasts between the proportions of Dunn's and Van Dyke's salamander observations in geographic categories relative to each of the proposed dam and reservoir, and elevation. The actual values of the proportions are given in **Appendix Table 5**. Lower and upper 95% confidence limits around the difference in those proportions are indicated, respectively, as L95% and U95%. Differences in proportions considered significant (where the confidence limits do not encompass zero) are shown in ***emboldened italics***.

	Dunn's Salamander			Van Dyke's Salamander		
	Difference	Confidence Limits		Difference	Confidence Limits	
Contrasts	in Proportions	L95%	U95%	in Proportions	L95%	U95%
Contrasts Relative to the Proposed Dam and Reservoir						
Below versus Within	0.0271	-0.2350	0.2892	-0.0154	-0.0453	0.0145
Below versus Above	0.0083	-0.2581	0.2746	***-0.2281***	***-0.3370***	***-0.1191***
Within versus Above	-0.0189	-0.1927	0.1549	***-0.0742***	***-0.3256***	***-0.0997***
Contrasts among Elevation Intervals						
Low versus Mid	-0.0936	-0.2791	0.0918	***-0.1496***	***-0.2629***	***-0.0364***
Low versus High	0.0947	-0.1342	0.3237	***-0.2868***	***-0.4893***	***-0.0844***
Mid versus High	0.1883	-0.0619	0.4387	-0.1372	-0.3664	0.0919

Figure 3. Distribution of the Dunn's and Van Dyke's salamanders relative to elevation. Number of unique sites sampled in each elevation category across all years combined are indicated below elevation category labels. Appendix Table 5 has the values for the proportions and their 95% confidence limits.



Analysis by three-month moving averages is somewhat more revealing of the differences between years.[8] In particular, the 2014-2015 Water Year, the driest year overall, was markedly drier by the March-May interval (see the three-month moving average in **Table 3**). Though the 2013-2014 Water Year was similar to the 2016-2017 Water Year over the March-May interval, the latter was much wetter in the fall. The latter pattern was similar to the 2015-2016 Water Year, which was the wettest year of the four during the fall and early winter even though it was not the wettest year in overall precipitation. Further, monthly variation across the Water Years was roughly three times as great in 2015-2016 and 2016-2017 as in 2013-2014 and 2014-2015.

[8] We used three-month moving averages of rainfall because lungless salamanders are thought to be affected by surface moisture over the interval preceding sampling. If precipitation is higher, we expect that soil moisture, especially that near the substrate surface, is higher over the same period, and hence, influences the amount of lungless salamander surface activity.

Table 3. Precipitation (inches) at the Doty Station for the Water Years compassing the four survey years in the Chehalis mainstem headwaters. Annual Variance is calculated from Monthly data.

	Water Year			
Month	2013/14	2014/15	2015/16	2016/17
October	2.08	7.75	6.41	13.76
November	5.21	6.11	11.35	11.81
December	4.23	7.43	16.28	7.73
January	6.23	8.03	9.38	4.11
February	7.62	5.68	6.34	9.25
March	10.24	4.67	10.60	10.95
April	5.46	2.86	2.49	6.49
May	3.51	1.22	0.85	3.64
June	0.88	0.42	2.15	1.49
July	1.14	0.03	0.53	0.12
August	1.09	2.78	0.42	0.26
September	2.40	1.10	2.37	1.72
Water Year Totals	50.09	48.08	69.17	71.33
Annual Variance	8.47	8.84	26.76	22.51
3-Month Interval	3-Month Moving Average			
Oct-Dec	11.52	21.29	34.04	33.30
Nov-Jan	15.67	21.57	37.07	23.65
Dec-Feb	18.08	21.14	32.00	21.09
Jan-Mar	24.09	18.38	26.32	24.31
Feb-Apr	23.32	13.21	19.43	26.69
Mar-May	19.21	8.75	13.94	21.08
Apr-Jun	9.85	4.50	5.49	11.62
3-Month Means ($\bar{x}$)	17.39	15.55	24.03	23.11

DISCUSSION

Surveys were expressly designed to detect terrestrial salamanders; as expected, most amphibians found were terrestrial salamanders. However, almost 500 amphibians representing at least eight additional species were also incidentally recorded during these surveys. Our recording of such richness incidentally likely reflects the high amphibian species richness known to occur in the Chehalis Basin, which is the highest in Washington State and equaled only by a few small areas in the South Cascades (Dvornich et al. 1997). That this richness occurs in a landscape managed entirely for timber resources deserves recognition.

Western red-backed salamander was the most frequently recorded terrestrial amphibian; this agrees with previous work on Western red-backed salamanders, which require relatively mesic terrestrial habitats, are typically the most frequently recorded terrestrial salamander in the generally more mesic Willapa Hills (M. Hayes, unpublished data) as well as generally in Coast Ranges habitats in Washington (Raphael et al. 2002). This is in contrast to somewhat less mesic terrestrial habitat in the Cascade Range of Washington and at latitudes further south in Oregon.

Ensatina, a relatively drier habitat-adapted terrestrial salamander species, was much less frequent than the Western red-backed salamander in this mesic Coast Range habitat, a pattern also recorded elsewhere (Raphael et al. 2002). Ensatina tends to be more frequent in more interior, forested Oregon and Washington (Bury et al. 1991). Further, our surveys were riparian-focused to enable detecting Dunn's and Van Dyke's salamanders, they would be expected to be less frequent in the riparian margin than in the drier adjacent uplands.

Dunn's salamander was more frequently recorded than Ensatina, which likely reflects the riparian-focused nature of our surveys. Dunn's salamander, a terrestrial species with greater moisture requirements than Ensatina, is more stream-associated and the terrestrial amphibian surveys were stream margin-focused. We did not survey the less mesic uplands away from the stream, where more Ensatina might be expected. Dunn's salamander was relatively frequently recorded within the footprint of the proposed dam and reservoir (**Figure 2**), but appears to be less frequent at higher elevations (**Figure 3**).

Van Dyke's salamander was infrequently recorded. Van Dyke's salamander, also a strongly stream-associated species, is the least frequently recorded terrestrial salamander in several Coast Range habitats and other studies in western Washington (Wilkins and Peterson 2000, Raphael et al. 2002, McIntyre 2003, Wilk et al. 2014). Only two historical records existed for Van Dyke's salamander from the upper Chehalis system prior to these surveys (WDFW WSDM database, accessed 12 February 2014). Both records originated from the studies that Weyerhaeuser conducted when they developed their Landscape Conservation Plan across the Willapa Hills landscape in the 1990s and both come from what is best described as mid-elevation in the Chehalis headwaters (around 1300 feet [400 m]). We found Van Dyke's salamander at five new sites in 2017, all of which were above the proposed footprint of the dam. Though Van Dyke's salamander has been found at few sites overall (n = 14), the distribution of sites at which it was found indicates that the species is more frequent above (n = 13) than within (n = 1) the proposed dam/reservoir footprint (**Figure 2**). However, the pattern is consistent with this species being a cool-adapted stenotherm, since the old Forest Service *Survey and Manage Species* criteria for Van Dyke's salamander recommend that surveys be conducted at air temperatures ≤15°C [59°F] (Jones 1999), and temperatures that satisfy its presumed optimal thermal regime are more frequent at the higher elevations.

Perhaps the most striking difference between years is the higher numbers of amphibians per sites encountered in 2016 and 2017 when contrasted to 2014 and 2015. In particular, we found 21.6 amphibians per sample site in 2017, 14.7 amphibians per sample site in 2016, this contrasts to 6.6 amphibians/site in 2014 and 11.0 amphibians per site in 2015. Some of this pattern likely reflects greater terrestrial salamander surface activity under the wetter conditions observed in 2016 and 2017; the October 2015-March 2016 interval was regionally the wettest in the historical record. However, regardless of whether you view the amphibians/site and wetness relationship as a moving average or not, the relationship seems complex in a non-linear fashion. For example, the highest numbers of amphibians recorded was in 2017, but the 2016-2017 water year was not the wettest. Implicit is something other than wetness contributes to the observed numbers.

The differential distribution pattern between Dunn's and Van Dyke's salamanders in the Chehalis mainstem headwaters has different implications for each species that in the event of construction of either an FRO or FRFA dam option. In particular, Dunn's salamander would lose significant habitat with the reservoir footprint in either option, whereas Van Dyke's salamander would proportionally lose much less suitable habitat. Both the FRO and FRFA options are anticipated to eliminate riparian habitat having the structure that could currently support either Dunn's or Van Dyke's salamanders. Vegetation removal in the reservoir footprint is expected under either option, and the new riparian margin conditions are not only unlikely to be suitable (new tree development will likely be intentionally suppressed), but the dynamics of stage (water level), seasonal in the FRFA and irregular in the FRO, are unlikely to create riparian conditions that would promote re-establishment of these two species. And re-establishment would assume that disturbance frequency would be low enough that it could actually occur. Since the habitat for both these salamanders is exclusively riparian, the reservoir footprints for either dam option are likely to also isolate Dunn's and Van Dyke's salamander populations in tributaries adjacent to one another in the Chehalis mainstem where habitat for both species is anticipated to remain. What that this kind of isolation will do to local gene flow in populations of both these species is vague?

In the anticipated climate change trajectory, we might expect Van Dyke's salamander to retreat upwards in elevation as the seemingly sparse low-elevation populations are lost, whereas Dunn's salamander would be expected to expand upwards in elevation as higher elevations become thermally more favorable. However, at some point, Dunn's salamander expansion upward in elevation may be coupled with a retreat along its lower-elevation limit. Both these patterns are justification for including acquisitions in the headwater portions of this system to help attenuate the effects of the climate change trajectory as part of the ASRP restoration options.

The Chehalis mainstem headwaters is one of only two basins were Dunn's salamander is present in the Chehalis Basin overall, whereas Van Dyke's salamander is likely present in three general areas in the overall basin. Besides the Willapa Hills, Van Dyke's salamander is present in headwater areas of the Chehalis Basin streams (Humptulips, Satsop, Wynoochee) draining the Olympics (Dvornich et al. 1997), and likely present in the Cascade slope area of the basin. Some uncertainty exists about the latter because the Chehalis Basin has limited area across the Cascade slope at mid- to higher elevations, and as found in this study, the frequency of Van Dyke's occurrence increases with elevation. These conditions deserve consideration when considering Dunn's and Van Dyke's salamanders for both the targets of restoration and monitoring.

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APPENDIX I – SURVEYS COMPLETED IN 2014

We had a planned 51-site survey target and surveyed 58 sites (**Table 1**). Four of the 4 sites were located below the inundation footprint of the potential dam/reservoir, 34 sites were located within the footprint, and 20 sites were located upstream of the footprint (see **Figure 1**).

We recorded observations of 338 individuals of up to 12 species of amphibians at 49 of the 58 sites sampled, plus 7 incidental sites (**Appendix Table 1, Appendix Figures 1a, 1b** and **1c**). The four species of terrestrial amphibians recorded represent 72.8% of observations; the 8 non-terrestrial species we recorded represented 27.2% of observations.

Western red-backed salamanders was the most frequently encountered terrestrial salamander species, representing 78.0% of total observations and recorded at 63.8% of sites (**Appendix Table 1**). The next most frequently encountered at 24.1% of sites, was Dunn's salamander and Ensatina, representing 9.8% and 7.3% of observations respectively (**Appendix Table 1**). Van Dyke's salamander was the least frequently recorded species, recorded at 3.4% of sites and representing 4.9% of observations (**Appendix Table 1**). The four terrestrial amphibians also differed in the mean number of individuals recorded per site sampled. For official (that is non-incidental) survey sites (n = 58) at which they were found, Van Dyke's salamanders had the highest mean number of individuals per site (6.0 individuals/site), followed by Western red-back salamanders (5.7 individuals/site), Dunn's salamanders (1.8 individuals/site), and Ensatina (1.2 individuals/site).[9]

[9] The number of individuals per sites was calculated from the number of sites where at least one of each species was found.

APPENDIX II – SURVEYS COMPLETED IN 2015

We met our planned 30-site target sites surveyed, including the two sites sampled in 2014 where Van Dyke's salamander had been found (**Table 1**). Three of the 30 sites were located below the inundation footprint of the potential dam/reservoir, 16 sites were located within the footprint, and 11 sites were located upstream of the footprint (see **Figure 1**). The resurveyed Van Dyke's salamander sites included one within the footprint of the potential dam/reservoir and one upstream of the footprint.

We recorded observations of 355 individuals of at least 10 species of amphibians at the 29 of the 30 sites sampled, plus three incidental sites (**Appendix Table 2, Appendix Figures 2a, 2b** and **2c**). We found no amphibians at one site within the inundation pool. The four species of terrestrial amphibians (all salamanders) recorded represent 81.7% of observations; the 6 non-terrestrial species we recorded represented 18.3% of observations.

Western red-backed salamanders had also been the most frequently encountered terrestrial salamander species, representing 63.1% of total observations and recorded at 83.3% of sites (**Appendix Table 2**). The second most frequently encountered was Dunn's salamander, representing 23.4% of observations and 50% of sites (**Appendix Table 2**). Ensatina and Van Dyke's salamander were the two least frequently recorded species, both being found at 16.7% of sites and representing 3.1% and 10.3% of observations (**Appendix Table 2**). For official (that is non-incidental) survey sites (n=30) at which they were found, the four terrestrial amphibians also differed in the mean number of individuals recorded per site sampled. Western red-back salamanders had the highest mean number of individuals per site (7.2 individuals/site), followed by Van Dyke's salamanders (5.8 individuals/site), Dunn's salamanders (4.5 individuals/site), and Ensatina (1.5 individuals/site).[10]

APPENDIX III – SURVEYS COMPLETED IN 2016

We had exceeded our planned 30-site target with 37 sites surveyed, including the five sites where Van Dyke's salamander had been previously found in 2014 and 2015 (**Table 1**). Four of the 37 sites were located below the inundation footprint of the potential dam/reservoir, 17 sites were located within the footprint, and 16 sites were located above the footprint (see **Figure 1**).

We recorded observations of 545 individuals of 12 species of amphibians at the 37 sites sampled, plus one incidental site (**Appendix Table 3, Appendix Figures 3a, 3b** and **3c**). We found at least one species of amphibian at all 37 sites. The four species of terrestrial amphibians (all salamanders) recorded represent 69.5% of observations; the 6 non-terrestrial species we recorded represented 30.5% of observations.

Western red-backed salamanders (*Plethodon vehiculum*) had also been the most frequently encountered terrestrial salamander species, representing 61.5% of total observations and recorded at 89.2% of sites (**Appendix Table 3**). The second most frequently encountered was Dunn's salamander, representing 22.2% of observations and recorded at 48.6% of sites (**Appendix Table 3**). Van Dyke's salamander and Ensatina (*Ensatina eschscholtzii*) were the two least frequently recorded species, being found, respectively, at 24.3% and 27.0% of sites and representing 11.6% and 4.7% of observations (**Appendix Table 3**). The four terrestrial amphibians also differed in the mean number of individuals recorded per site sampled. For official (that is non-incidental) survey sites (n=37) at which they were found, western red-back salamanders had the highest mean number of individuals per site (7.1 individuals/site), followed by Van Dyke's salamanders (4.9 individuals/site), Dunn's salamanders (4.7 individuals/site), and Ensatina (1.8 individuals/site).[10]

APPENDIX IV – SURVEYS COMPLETED IN 2017

In 2017, we met our planned 30-site survey target, including resurvey of the nine unique sites where Van Dyke's salamanders were found in all previous year collectively (**Table 1**). We also met our target with regard to distribution, as six of the 30 sites were located below the footprint of the potential dam/reservoir, one site was located within the footprint, and 23 sites were located at elevations above the footprint (**Figure 1**). Resurveyed Van Dyke's salamander sites included the only one within the footprint of the potential dam/reservoir and eight above of the footprint.

We recorded observations of 613 individuals of up to 11 species of amphibians (Giant salamanders may represent two species) at 28 of the 30 sites sampled, plus one incidental site (**Appendix Table 4**and **Appendix Figure 4a, 4b and 4c**). We no found amphibians at two of the downstream surveyed sites. The three species of terrestrial amphibians (all salamanders) recorded represent 72.4% of observations; the 7 non-terrestrial amphibian species we recorded represented 27.6% of observations. In addition, we only found Van Dykes salamanders at 8 of the 9 resampled sites and found no Ensatina salamanders.

Western red-backed salamanders (*Plethodon vehiculum*) were the most frequently encountered terrestrial salamander species, representing 61.7% of total observations and was recorded at 86.7% of surveyed sites (**Appendix Table 4**). The second most frequently encountered was Dunn's salamander recorded at over half the sites (53.3%) but only representing 16.9% of observations, and Van Dyke's salamander, was the least frequently recorded species, representing 21.4% of those observations and recorded at 43.3% of sites (**Appendix Table 4**). In addition, we found no Ensatina salamanders during our 2017 surveys. The three terrestrial amphibians also differed in the mean number of individuals recorded per site sampled. For official (that is non-incidental) survey sites (n=30) at which they were found, Western red-back salamanders had the highest mean number of individuals per site (8.9 individuals/site), followed by Van Dyke's (7.5 individuals/site) and Dunn's salamanders (4.1 individuals/site).[10]

Appendix Table 1. Amphibian species and numbers of observations during terrestrial amphibian surveys, February-July 2014. Subtotals or totals for sites may be less than site sums for species across habitat categories because one or more species occurring at the same site. Observation categories: NS = Typical rubble-rouse surveys, Inc = Incidental/Light Touch.

Species		Numbers of *Sites* and *Individuals* (*Ind*) observed								
Standard English Name	Scientific Name		Below footprint		In footprint		Above footprint		**Totals**	
			Sites	*Ind*	*Sites*	*Ind*	*Sites*	*Ind*	*Sites*	*Ind*
Terrestrial Amphibians										
Dunn's salamander	*Plethodon dunni*	NS	0	0	7	15	6	8	**13**	**23**
		Inc	0	0	1	1	0	0	**1**	**1**
Ensatina	*Ensatina eschscholtzii*	NS	1	1	4	5	8	10	**13**	**16**
		Inc	0	0	1	1	0	0	**1**	**1**
Van Dyke's salamander	*Plethodon vandykei*	NS	0	0	1	5	1	7	**2**	**12**
		Inc	0	0	0	0	0	0	**0**	**0**
Western red-backed salamander	*Plethodon vehiculum*	NS	3	7	15	87	14	89	**32**	**183**
		Inc	0	0	3	7	2	2	**5**	**9**
	Subtotals	NS	**3**	**8**	**21**	**112**	**18**	**114**	**42**	**234**
		Inc	**0**	**0**	**4**	**9**	**2**	**2**	**6**	**11**
Stillwater-breeding Amphibians										
Pacific treefrog	*Pseudacris regilla*	NS	0	0	4	9	0	0	**4**	**9**
		Inc	0	0	1	1	0	0	**1**	**1**
Northern red-legged frog	*Rana aurora*	NS	1	1	0	0	1	1	**2**	**2**
		Inc	0	0	1	1	0	0	**1**	**1**
Roughskin newt	*Taricha granulosa*	NS	0	0	0	0	1	2	**1**	**2**
		Inc	0	0	2	2	0	0	**2**	**2**
Western toad	*Anaxyrus boreas*	NS	1	1	5	9	2	2	**8**	**12**
		Inc	0	0	1	1	0	0	**1**	**1**
	Subtotals	NS	**2**	**2**	**9**	**18**	**4**	**5**	**15**	**25**
		Inc	**0**	**0**	**5**	**5**	**0**	**0**	**5**	**5**
Stream-breeding Amphibians										
Giant salamanders	*Dicamptodon sp.*	NS	0	0	0	0	4	4	**4**	**4**
		Inc	0	0	0	0	0	0	**0**	**0**
Coastal tailed frog	*Ascaphus truei*	NS	0	0	5	6	3	5	**8**	**11**
		Inc	0	0	0	0	1	1	**1**	**1**
Columbia torrent salamander	*Rhyacotriton kezeri*	NS	0	0	4	32	7	11	**11**	**43**
		Inc	0	0	1	1	1	1	**2**	**2**
	Subtotals	NS	**0**	**0**	**9**	**38**	**12**	**20**	**21**	**58**
		Inc	**0**	**0**	**1**	**1**	**3**	**2**	**4**	**3**
	Overall Totals	NS	**3**	**10**	**22**	**168**	**17**	**140**	**48**	**317**
		Inc	**0**	**0**	**9**	**15**	**4**	**5**	**13**	**19**

FINAL REPORT FOR WORK GROUP DISTRIBUTION

Appendix Table 2. Amphibian species and numbers of observations during terrestrial amphibian surveys, March-April 2015. Subtotals/totals for sites may be less than site sums for species across habitat categories because one or more species occurring at the same site. Observation categories: NS = Typical rubble-rouse surveys, Inc = Incidental/Light Touch.

Species			**Numbers of *Sites* and *Individuals* (*Ind*) observed**							
Standard English Name	Scientific Name		Below footprint		In footprint		Above footprint		**Totals**	
			Sites	*Ind*	*Sites*	*Ind*	*Sites*	*Ind*	*Sites*	*Ind*
Terrestrial Amphibians										
Dunn's salamander	*Plethodon dunni*	NS	2	3	9	36	4	29	**15**	**68**
		Inc	0	0	0	0	0	0	**0**	**0**
Ensatina	*Ensatina eschscholtzii*	NS	1	2	3	4	2	3	**6**	**9**
		Inc	0	0	0	0	0	0	**0**	**0**
Van Dyke's salamander	*Plethodon vandykei*	NS	0	0	1	3	4	27	**5**	**30**
		Inc	0	0	0	0	0	0	**0**	**0**
Western red-backed salamander	*Plethodon vehiculum*	NS	3	5	11	59	11	117	**25**	**181**
		Inc	0	0	1	2	0	0	**1**	**2**
	Subtotals	NS	**3**	**10**	**13**	**102**	**10**	**176**	**26**	**288**
		Inc	**0**	**0**	**1**	**2**	**0**	**0**	**1**	**2**
Stillwater-breeding Amphibians										
Pacific treefrog	*Pseudacris regilla*	NS	1	3	2	5	1	2	**4**	**10**
		Inc	0	0	0	0	1	1	**1**	**1**
Northern red-legged frog	*Rana aurora*	NS	0	0	0	0	0	0	**0**	**0**
		Inc	0	0	0	0	0	0	**0**	**0**
Roughskin newt	*Taricha granulosa*	NS	0	0	1	1	0	0	**1**	**1**
		Inc	1	6	0	0	0	0	**1**	**6**
Western toad	*Anaxyrus boreas*	NS	0	0	7	7	1	1	**8**	**8**
		Inc	0	0	0	0	0	0	**0**	**0**
	Subtotals	NS	**1**	**3**	**8**	**13**	**2**	**3**	**11**	**19**
		Inc	**1**	**6**	**0**	**0**	**1**	**1**	**2**	**7**
Stream-breeding Amphibians										
Giant salamanders	*Dicamptodon sp.*	NS	0	0	0	0	1	2	**1**	**2**
		Inc	0	0	0	0	0	0	**0**	**0**
Coastal tailed frog	*Ascaphus truei*	NS	0	0	1	2	4	5	**5**	**7**
		Inc	0	0	0	0	0	0	**0**	**0**
Columbia torrent salamander	*Rhyacotriton kezeri*	NS	1	2	5	19	4	9	**10**	**30**
		Inc	0	0	0	0	0	0	**0**	**0**
	Subtotals	NS	**1**	**2**	**5**	**21**	**5**	**16**	**11**	**39**
		Inc	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Overall Totals	NS	**3**	**15**	**16**	**136**	**10**	**195**	**29**	**346**
		Inc	**1**	**6**	**1**	**2**	**1**	**1**	**3**	**9**

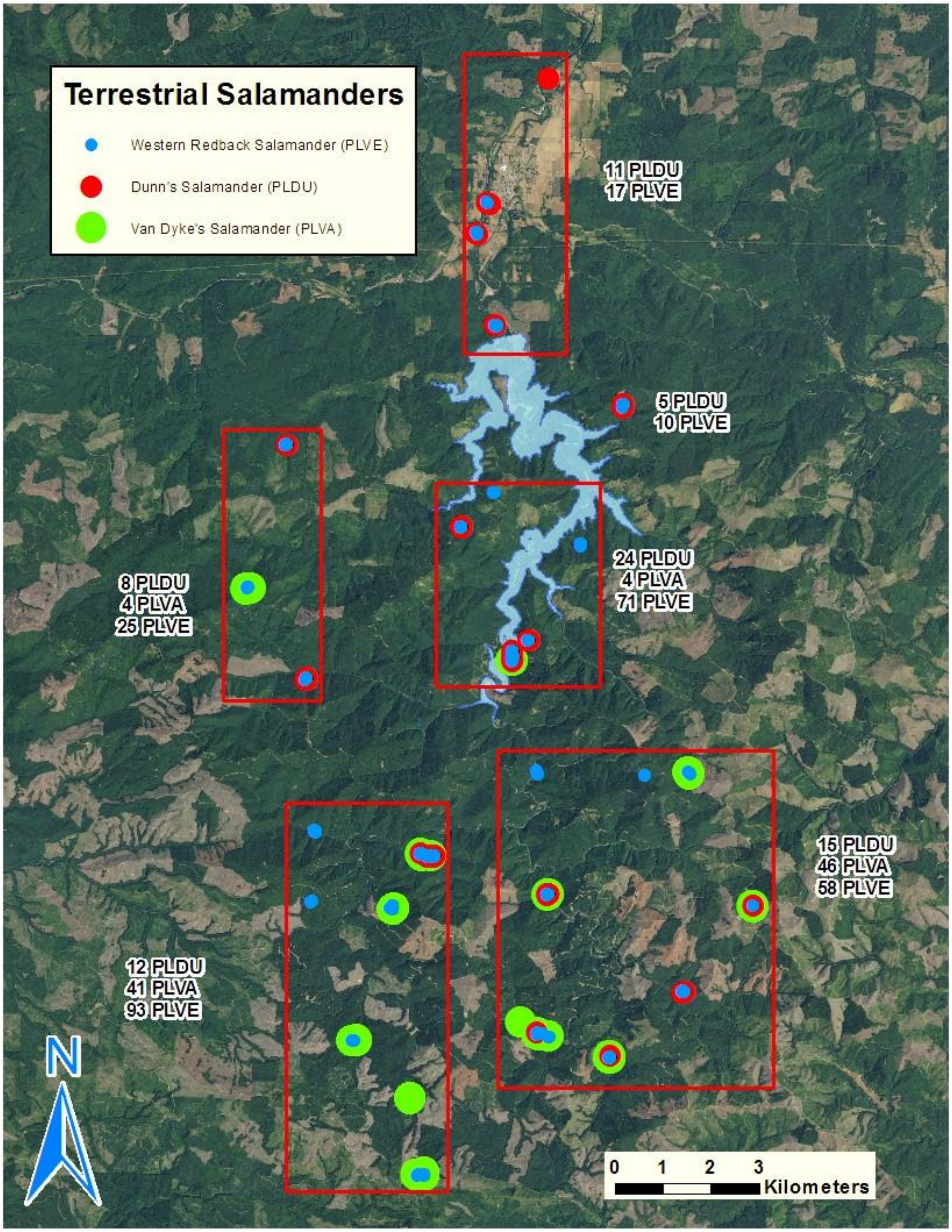
Appendix Table 3. Amphibian species and numbers of observations during terrestrial amphibian surveys, March-May 2016. Subtotals/totals for sites may be less than site sums for species across habitat categories because one or more species occurring at the same site. Observation categories: NS = Typical rubble-rouse surveys, Inc = Incidental/Light Touch.

Species		Numbers of *Sites* and *Individuals* (*Ind*) observed								
Standard English Name	Scientific Name		Below footprint		In footprint		Above footprint		Totals	
			Sites	*Ind*	*Sites*	*Ind*	*Sites*	*Ind*	*Sites*	*Ind*
Terrestrial Amphibians										
Dunn's salamander	*Plethodon dunni*	NS	1	1	10	44	7	39	**18**	**84**
		Inc	0	0	0	0	0	0	**0**	**0**
Ensatina	*Ensatina eschscholtzii*	NS	3	5	4	10	3	3	**10**	**18**
		Inc	0	0	0	0	0	0	**0**	**0**
Van Dyke's salamander	*Plethodon vandykei*	NS	0	0	1	2	8	42	**9**	**44**
		Inc	0	0	0	0	0	0	**0**	**0**
Western red-backed salamander	*Plethodon vehiculum*	NS	4	13	15	95	14	125	**33**	**233**
		Inc	0	0	0	0	0	0	**0**	**0**
	Subtotals	NS	**4**	**19**	**15**	**151**	**16**	**209**	**35**	**379**
		Inc	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Stillwater-breeding Amphibians										
Pacific treefrog	*Pseudacris regilla*	NS	0	0	5	7	1	1	**6**	**8**
		Inc	0	0	0	0	0	0	**0**	**0**
Northern red-legged frog	*Rana aurora*	NS	1	1	1	1	3	3	**5**	**5**
		Inc	0	0	0	0	0	0	**0**	**0**
Northwestern salamander	*Ambystoma gracile*	NS	3	4	1	1	1	1	**5**	**6**
		Inc	0	0	0	0	0	0	**0**	**0**
Roughskin newt	*Taricha granulosa*	NS	1	1	2	2	3	5	**6**	**8**
		Inc	0	0	0	0	0	0	**0**	**0**
Western toad	*Anaxyrus boreas*	NS	0	0	7	20	3	3	**10**	**23**
		Inc	0	0	1	1	0	0	**1**	**1**
	Subtotals	NS	**3**	**6**	**9**	**31**	**9**	**13**	**21**	**50**
		Inc	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**1**
Stream-breeding Amphibians										
Giant salamanders	*Dicamptodon sp.*	NS	1	1	0	0	5	13	**6**	**14**
		Inc	0	0	0	0	0	0	**0**	**0**
Coastal tailed frog	*Ascaphus truei*	NS	1	1	1	1	7	16	**9**	**18**
		Inc	0	0	0	0	0	0	**0**	**0**
Columbia torrent salamander	*Rhyacotriton kezeri*	NS	1	3	6	30	11	50	**18**	**83**
		Inc	0	0	0	0	0	0	**0**	**0**
	Subtotals	NS	**3**	**5**	**7**	**31**	**13**	**79**	**23**	**115**
		Inc	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Overall Totals	NS	**4**	**30**	**17**	**213**	**16**	**301**	**37**	**544**
		Inc	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**1**

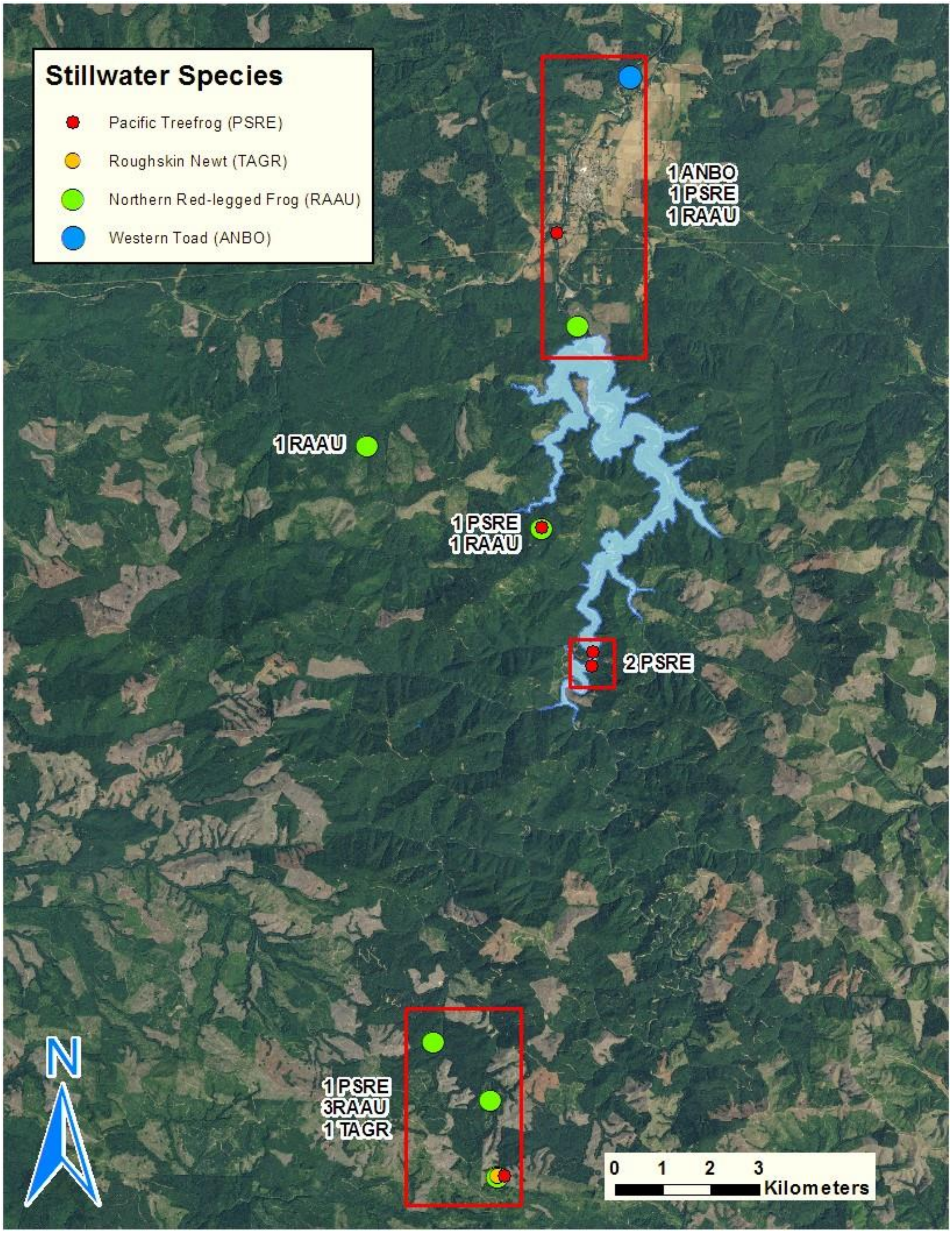
Appendix Table 4. Amphibian species and numbers of observations during terrestrial amphibian surveys, March-June 2017. Subtotals/totals for sites may be less than site sums for species across habitat categories because one or more species occurring at the same site. Observation categories: NS = Typical rubble-rouse surveys, Inc = Incidental/Light Touch.

Species		Numbers of *Sites* and *Individuals* (*Ind*) observed								
Standard English Name	Scientific Name		Below footprint		In footprint		Above footprint		Totals	
			Sites	*Ind*	*Sites*	*Ind*	*Sites*	*Ind*	*Sites*	*Ind*
Terrestrial Amphibians										
Dunn's salamander	*Plethodon dunni*	NS	4	11	0	0	9	42	**13**	**53**
		Inc	0	0	1	9	2	13	**3**	**22**
Ensatina	*Ensatina eschscholtzii*	NS	0	0	0	0	0	0	**0**	**0**
		Inc	0	0	0	0	0	0	**0**	**0**
Van Dyke's salamander	*Plethodon vandykei*	NS	0	0	0	0	8	60	**8**	**60**
		Inc	0	0	1	4	4	31	**5**	**35**
Western red-backed salamander	*Plethodon vehiculum*	NS	3	17	0	0	18	170	**21**	**187**
		Inc	0	0	1	30	5	57	**6**	**87**
Subtotals		NS	**4**	**28**	**0**	**0**	**19**	**272**	**23**	**300**
		Inc	**0**	**0**	**1**	**43**	**5**	**101**	**6**	**144**
Stillwater-breeding Amphibians										
Pacific treefrog	*Pseudacris regilla*	NS	1	1	0	0	2	2	**3**	**3**
		Inc	0	0	1	2	0	0	**1**	**2**
Northern red-legged frog	*Rana aurora*	NS	1	1	0	0	4	4	**5**	**5**
		Inc	0	0	0	0	1	1	**1**	**1**
Roughskin newt	*Taricha granulosa*	NS	0	0	0	0	0	0	**0**	**0**
		Inc	0	0	0	0	1	1	**1**	**1**
Western toad	*Anaxyrus boreas*	NS	1	1	0	0	0	0	**1**	**1**
		Inc	0	0	0	0	0	0	**0**	**0**
Subtotals		NS	**3**	**3**	**0**	**0**	**5**	**6**	**8**	**9**
		Inc	**0**	**0**	**1**	**2**	**1**	**2**	**2**	**4**
Stream-breeding Amphibians										
Giant salamanders	*Dicamptodon sp.*	NS	0	0	0	0	8	14	**8**	**14**
		Inc	0	0	1	1	2	6	**3**	**7**
Coastal tailed frog	*Ascaphus truei*	NS	0	0	0	0	8	15	**8**	**15**
		Inc	0	0	0	0	1	3	**1**	**3**
Columbia torrent salamander	*Rhyacotriton kezeri*	NS	1	2	0	0	13	100	**14**	**102**
		Inc	0	0	1	5	3	10	**4**	**15**
Subtotals		NS	**1**	**2**	**0**	**0**	**18**	**129**	**19**	**131**
		Inc	**0**	**0**	**1**	**6**	**3**	**19**	**4**	**25**
Overall Totals		NS	**4**	**33**	**1**	**51**	**24**	**529**	**28**	**440**
		Inc	**0**	**0**	**0**	**0**	**1**	**8**	**1**	**173**

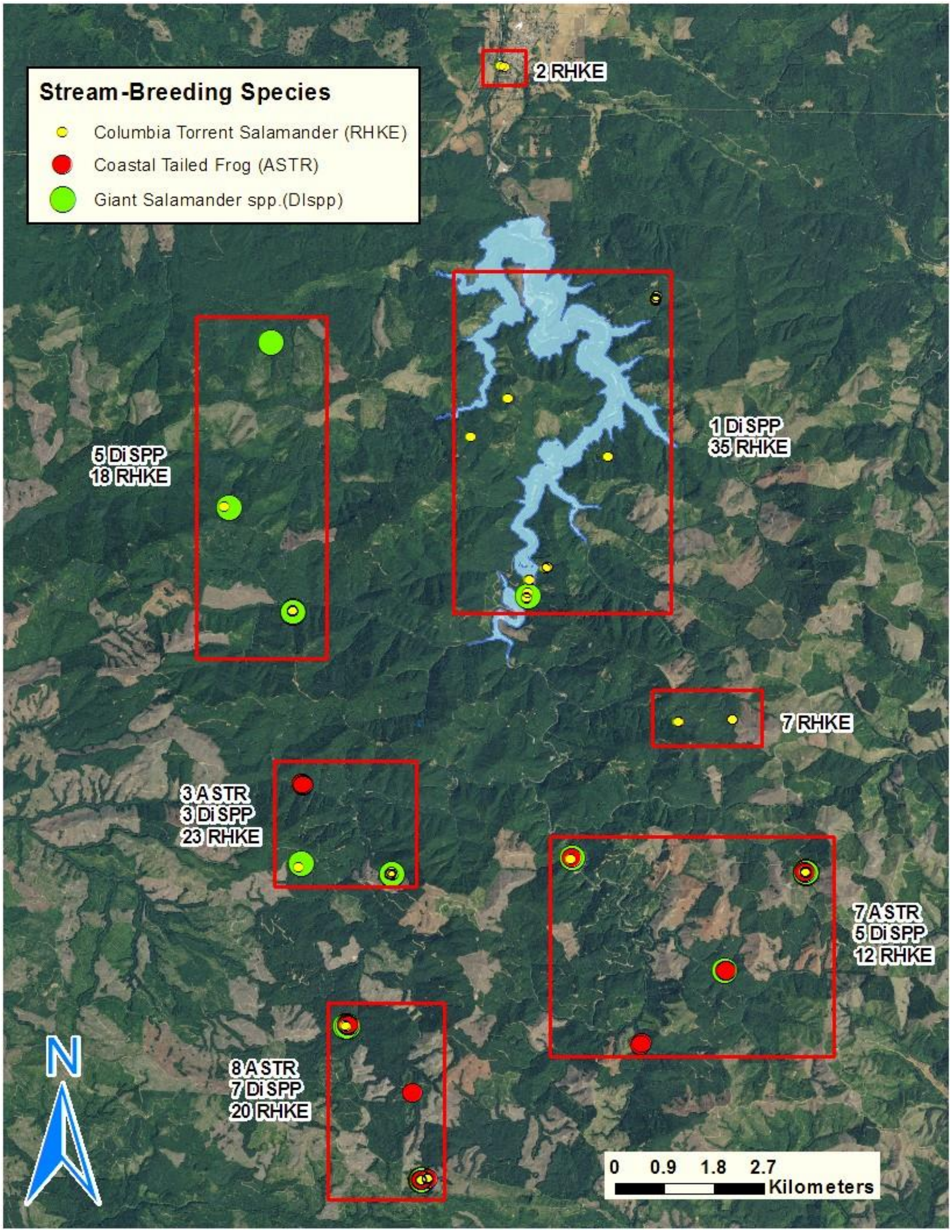
Appendix Figure 1a. Distribution of terrestrial amphibians, including stream-associated taxa, encountered in 2014. Numbers of specific taxa are summarized adjacent to either individual points or boxes encompassing groups of individual points.



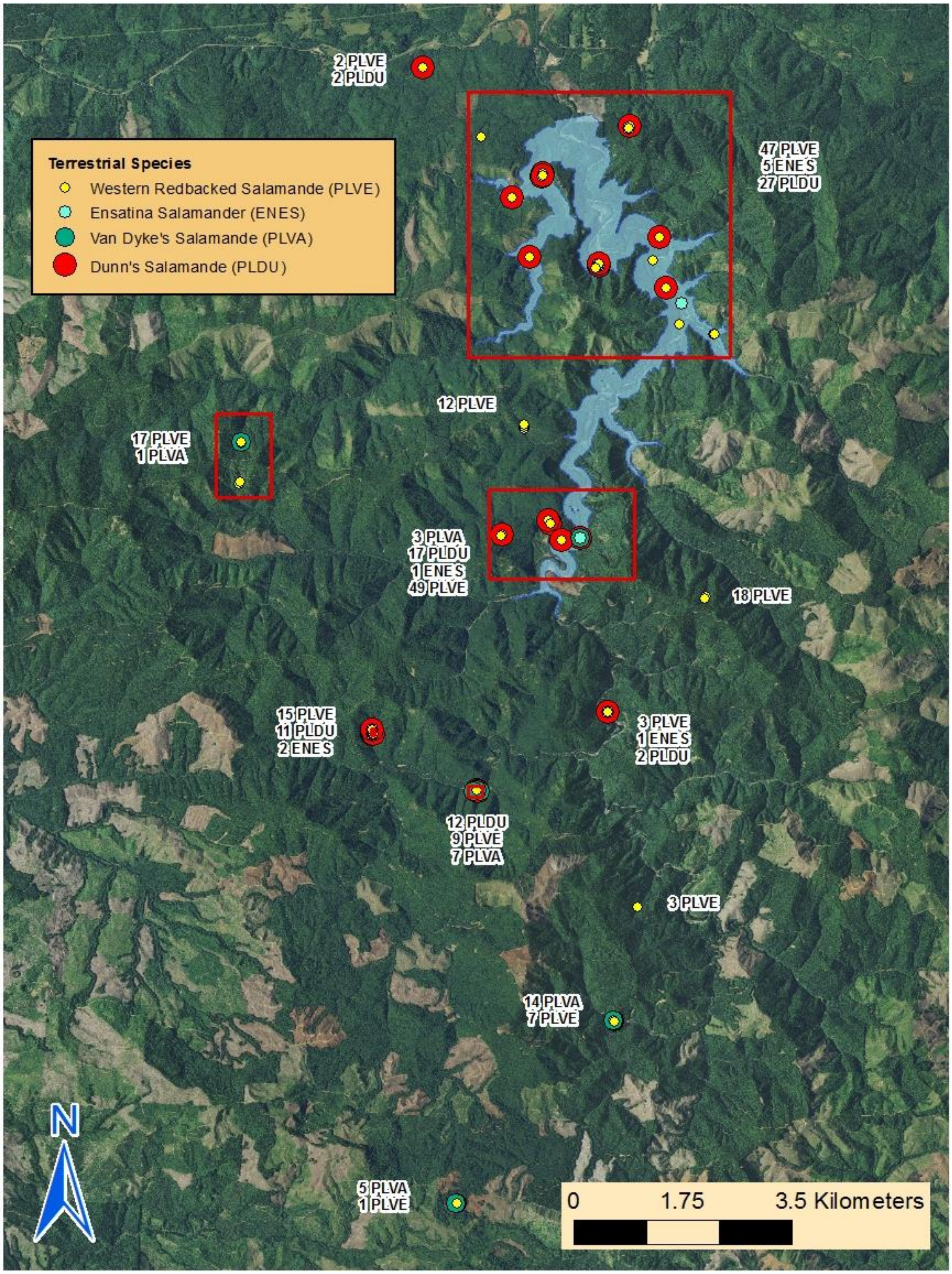
Appendix Figure 1b. Distribution of stillwater-breeding amphibians incidentally recorded during stream-associated amphibian surveys in 2014. Numbers of specific taxa are summarized next to individual points.



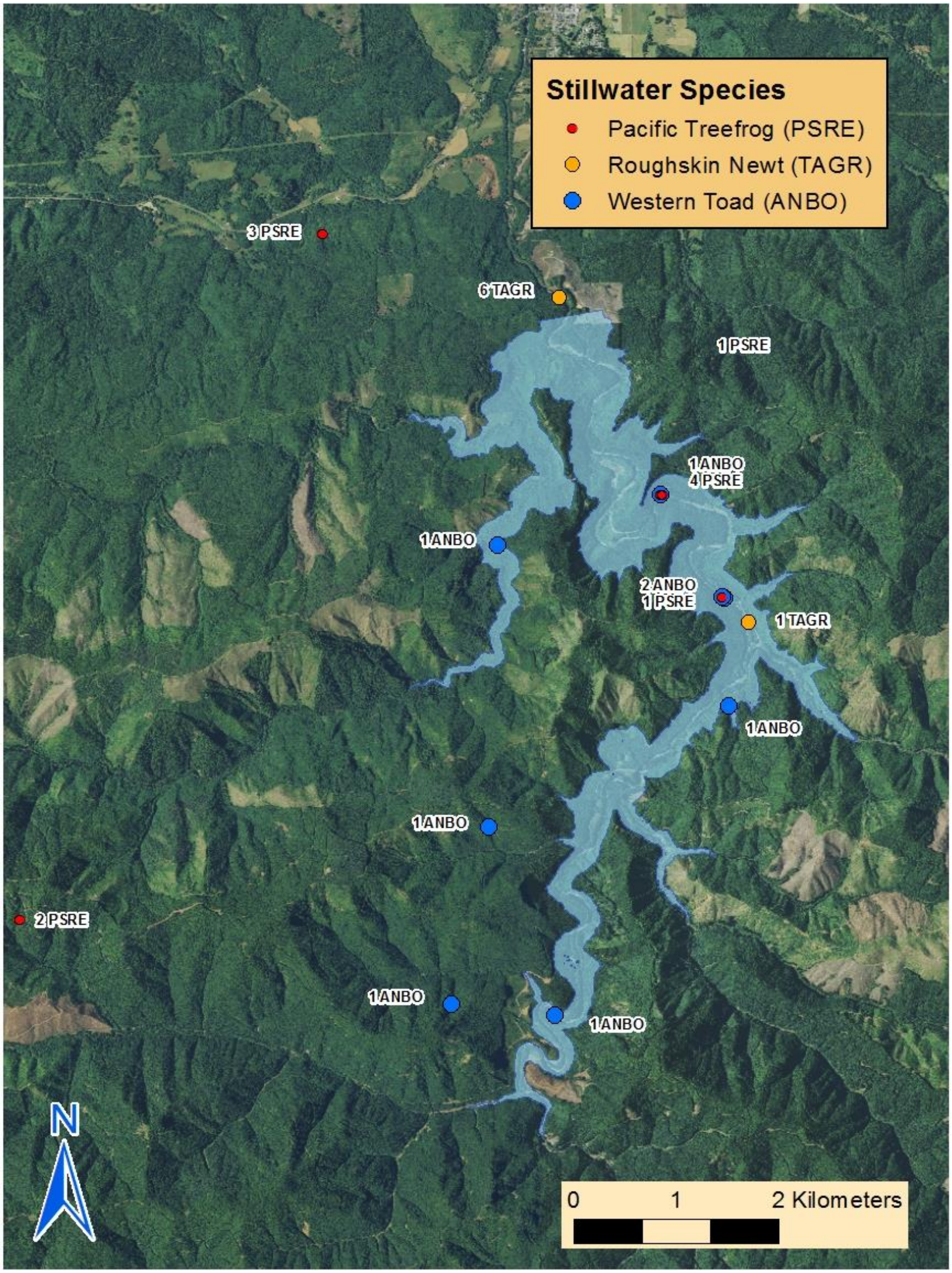
Appendix Figure 1c. Distribution of stream-breeding amphibians incidentally recorded during stream-associated amphibian surveys in 2014. Numbers of specific taxa are summarized adjacent to either individual points or boxes encompassing groups of individual points.



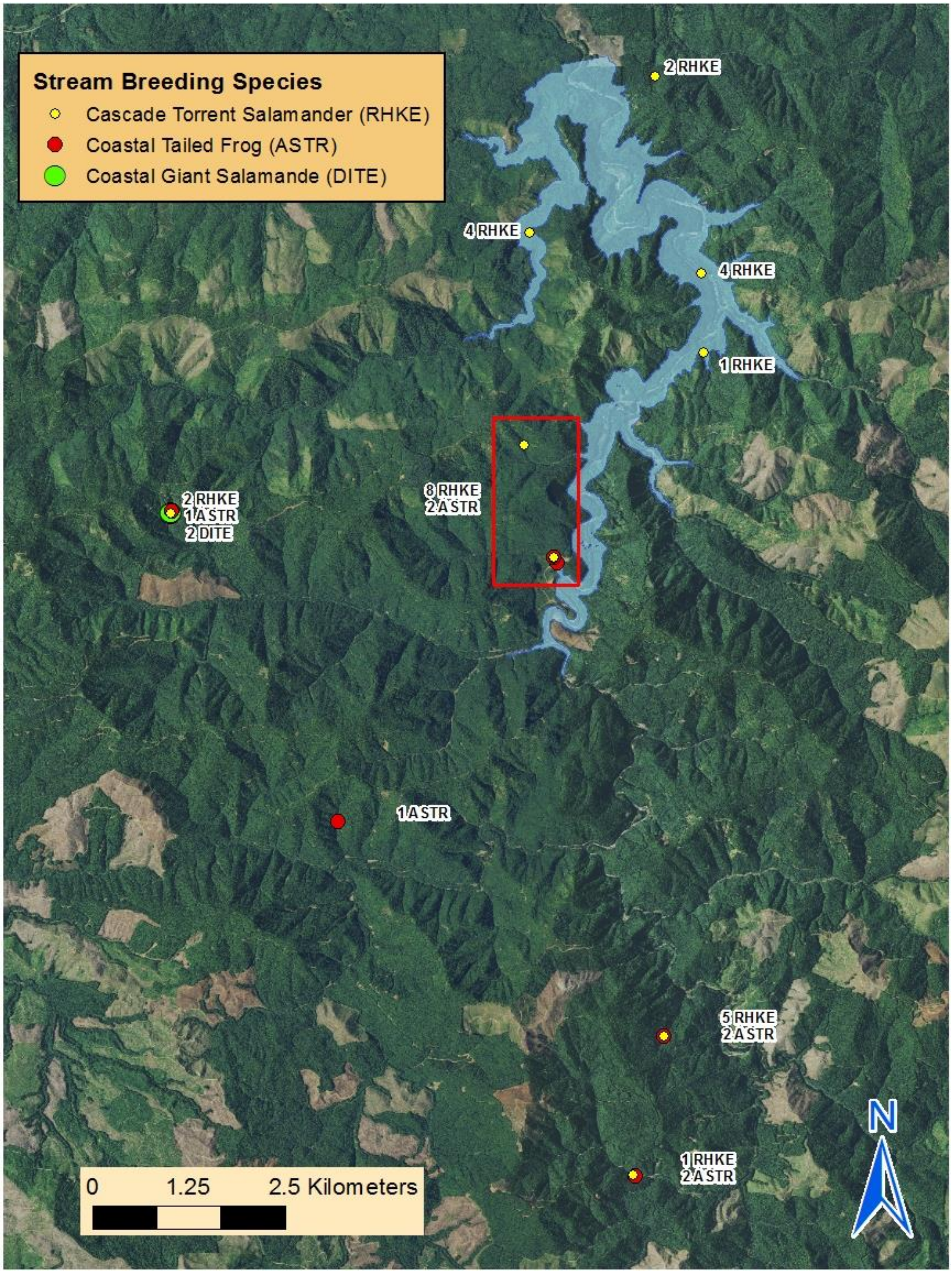
Appendix Figure 2a. Distribution of terrestrial amphibians, including stream-associated taxa, encountered in 2015. Numbers of specific taxa are summarized adjacent to either individual points or boxes encompassing groups of individual points.



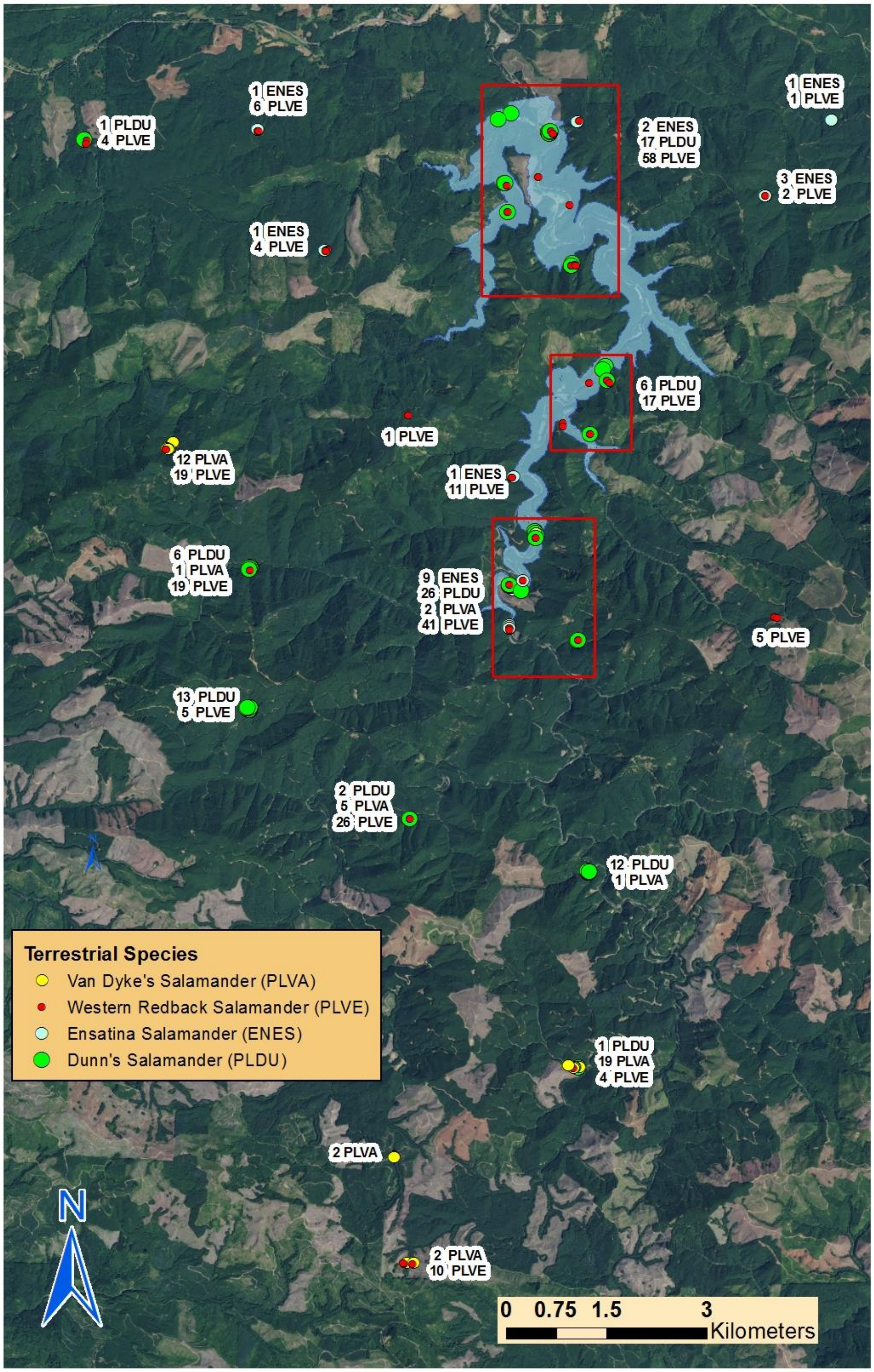
Appendix Figure 2b. Distribution of stillwater-breeding amphibians incidentally recorded during stream-associated amphibian surveys in 2015. Numbers of specific taxa are summarized next to individual points.



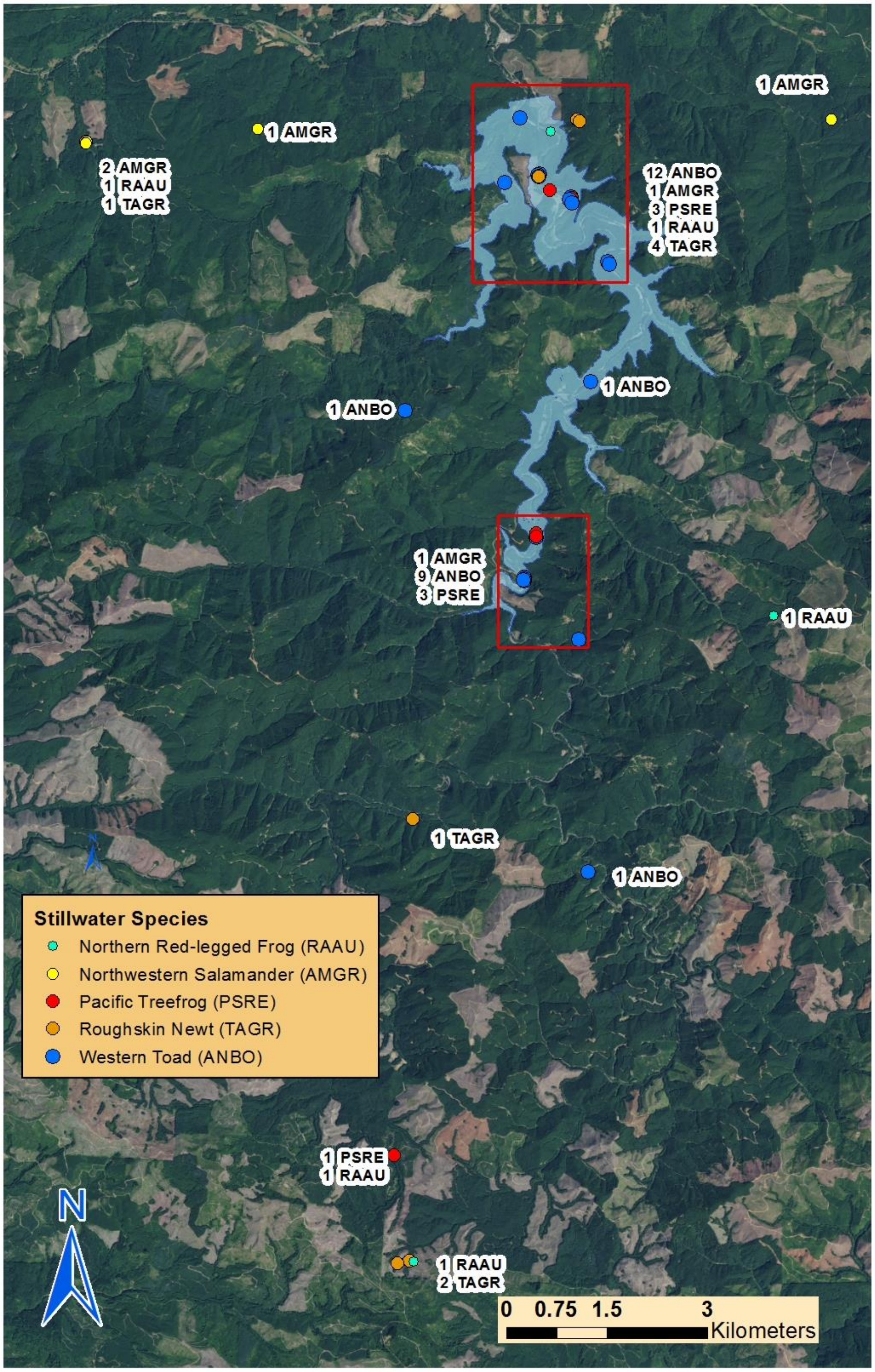
Appendix Figure 2c. Distribution of stream-breeding amphibians incidentally recorded during stream-associated amphibian surveys in 2015. Numbers of specific taxa are summarized adjacent to either individual points or boxes encompassing groups of individual points.



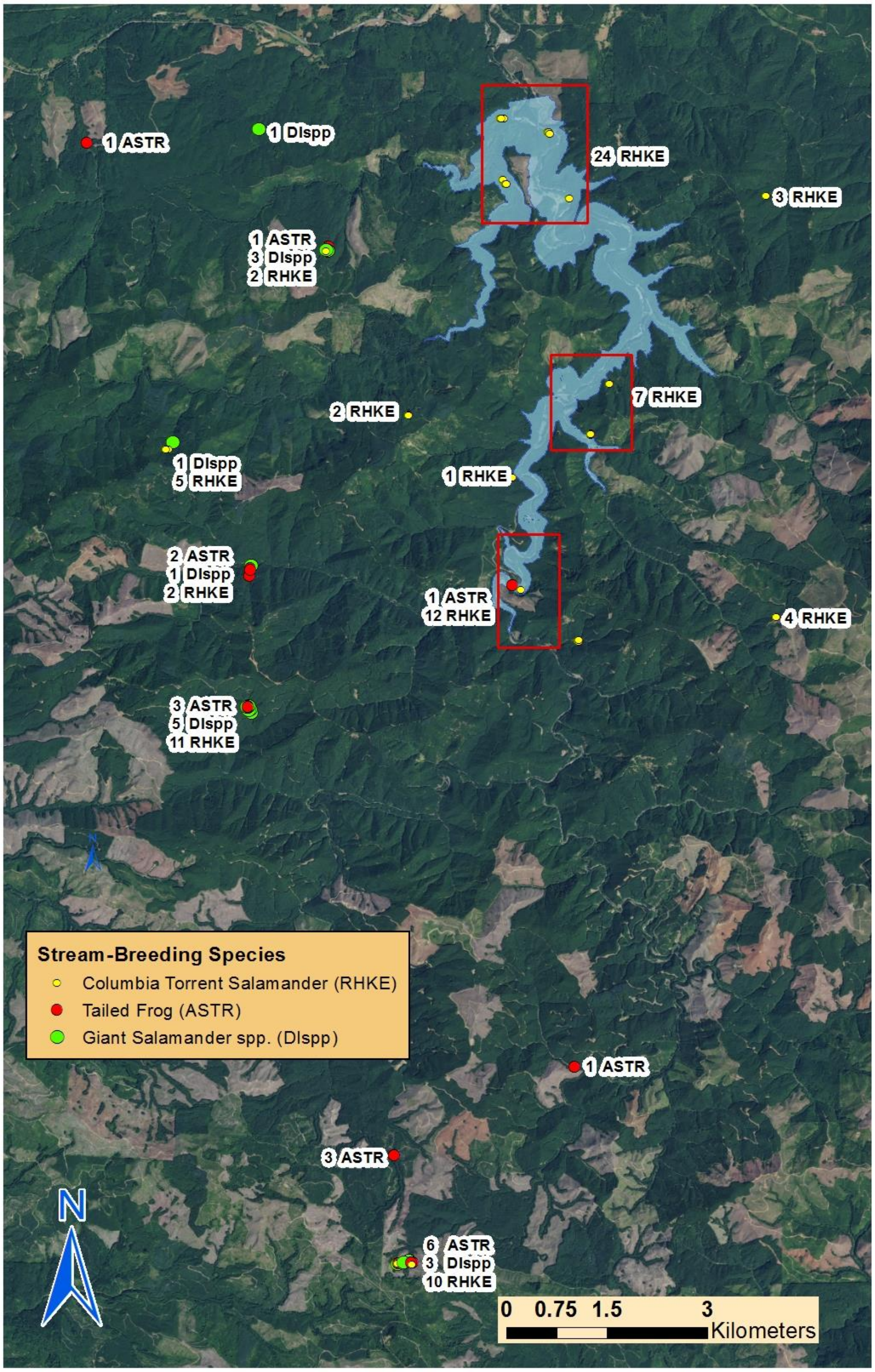
Appendix Figure 3a. Distribution of terrestrial amphibians, including stream-associated taxa, encountered in 2016. Numbers of specific taxa are summarized adjacent to either individual points or boxes encompassing groups of individual points.



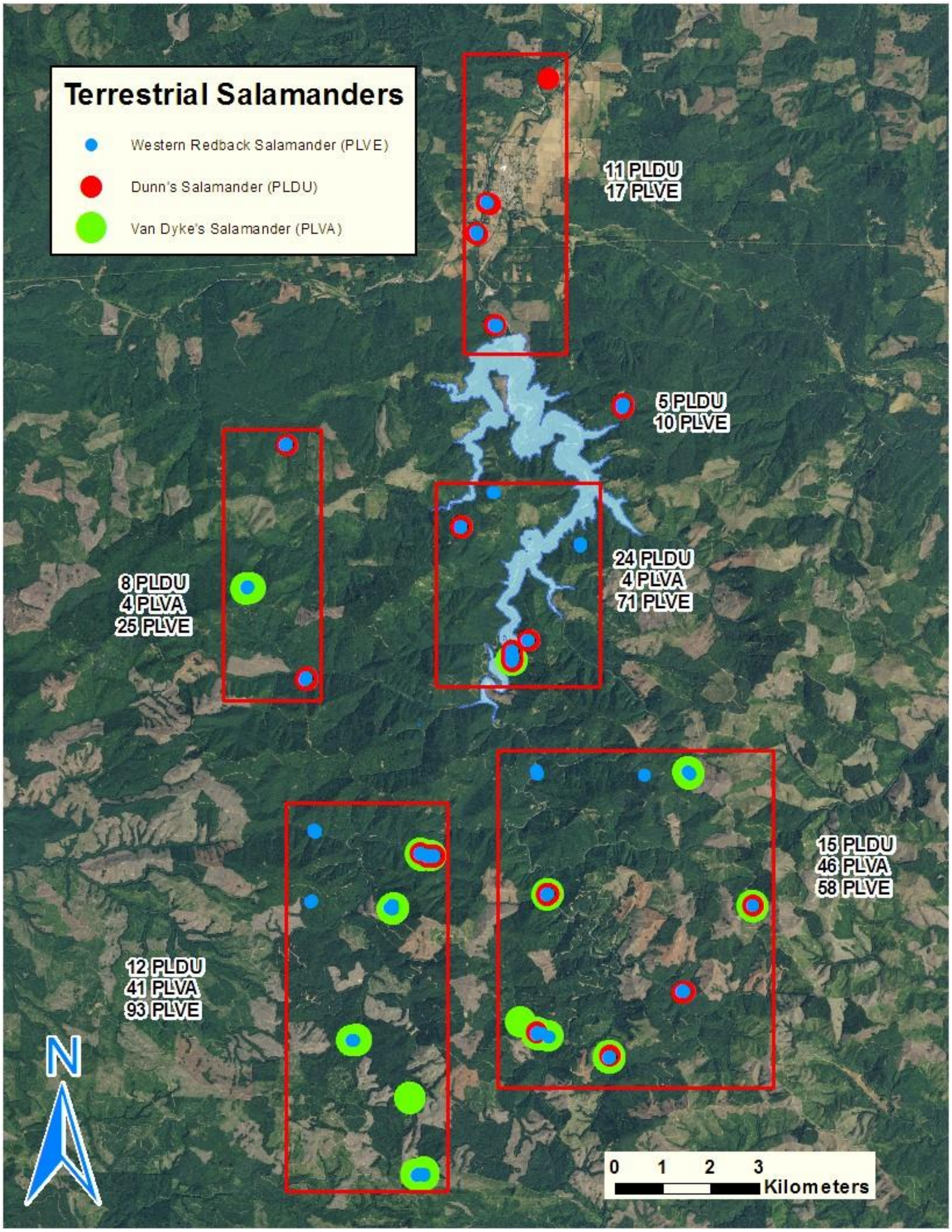
Appendix Figure 3b. Distribution of stillwater-breeding amphibians incidentally recorded during stream-associated amphibian surveys in 2016. Numbers of specific taxa are summarized next to individual points or boxes encompassing groups of individual points.



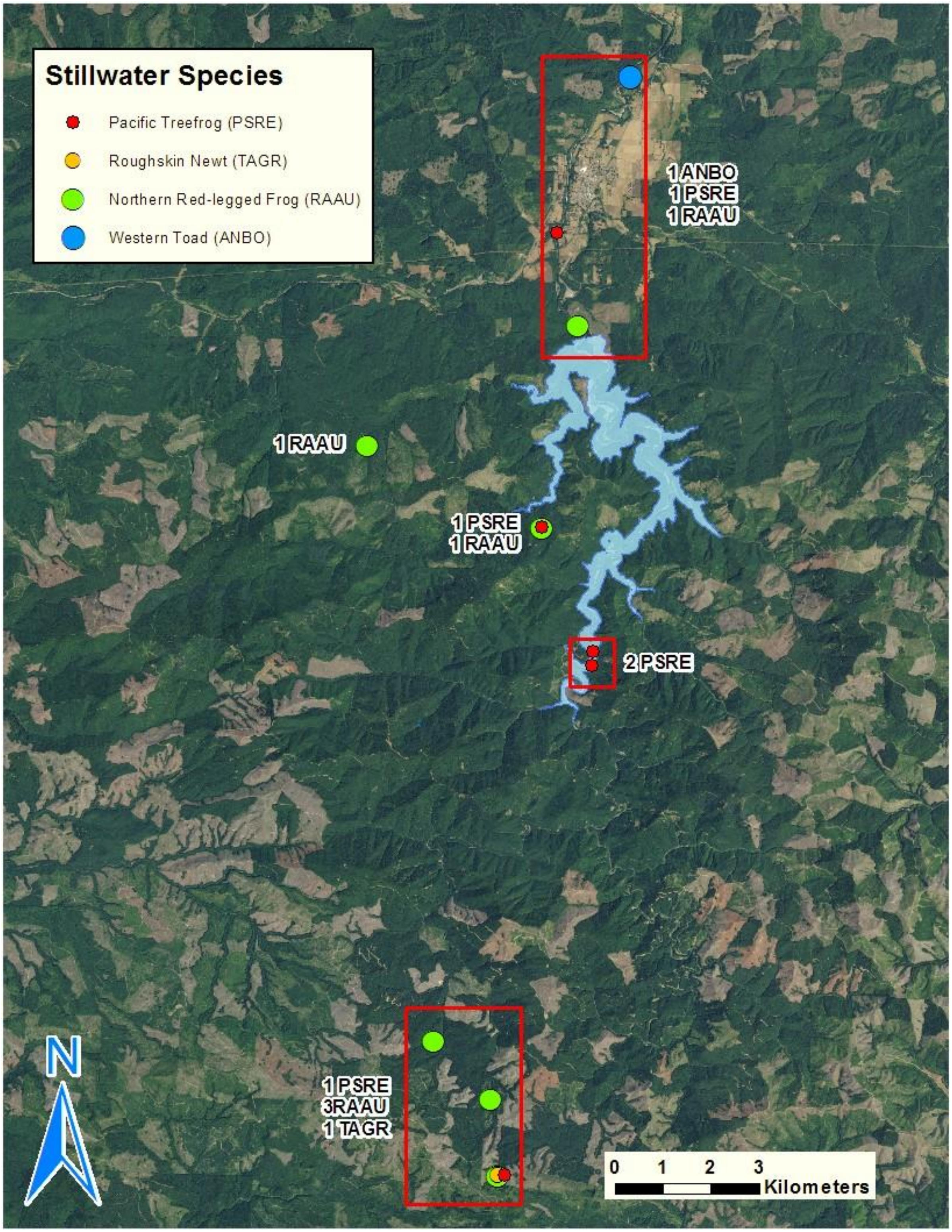
Appendix Figure 3c. Distribution of stream-breeding amphibians incidentally recorded during stream-associated amphibian surveys in 2016. Numbers of specific taxa are summarized adjacent to either individual points or boxes encompassing groups of individual points.



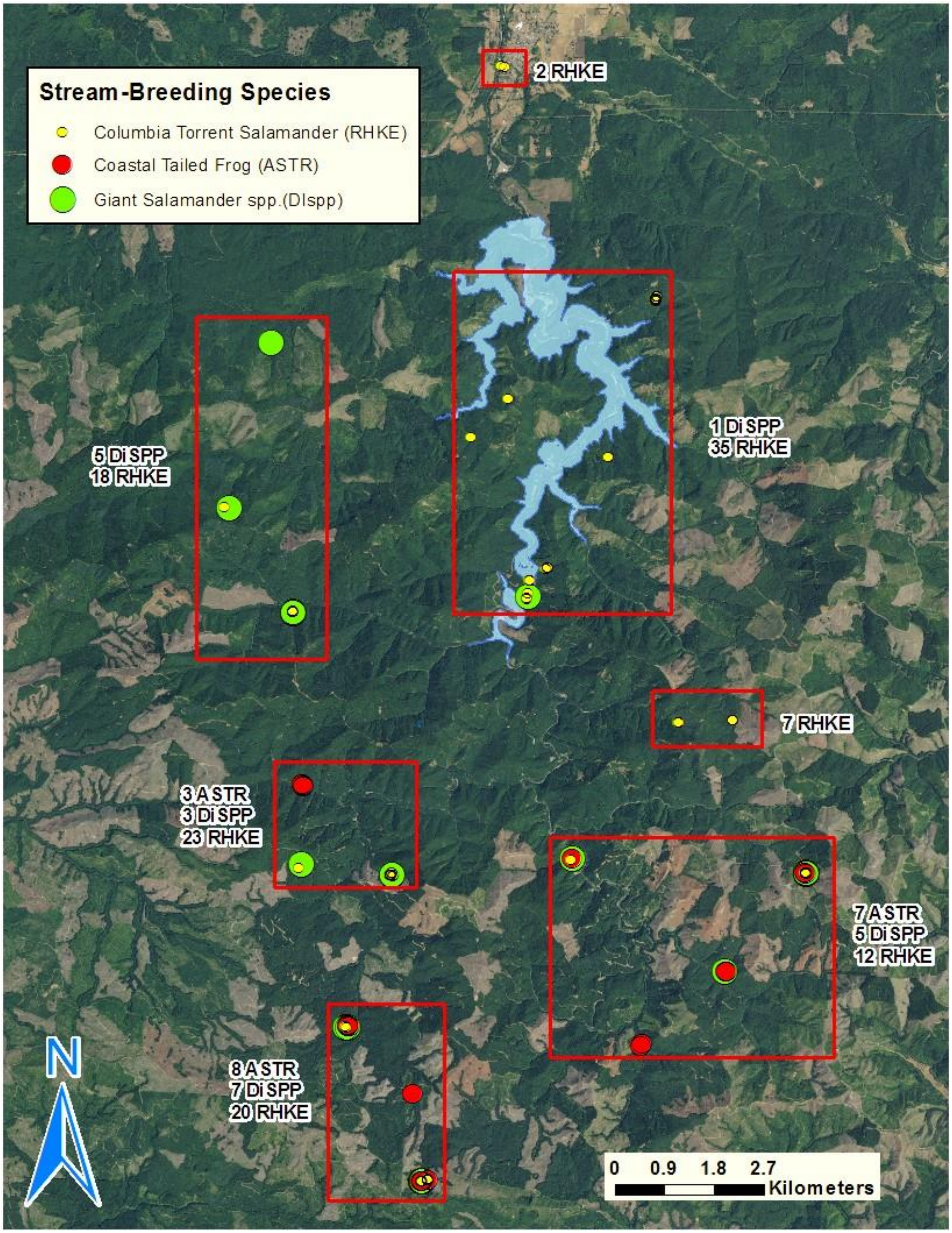
Appendix Figure 4a. Distribution of terrestrial amphibians, including stream-associated taxa, encountered in 2017. Numbers of specific taxa are summarized adjacent to either individual points or boxes encompassing groups of individual points.



Appendix Figure 4b. Distribution of stillwater-breeding amphibians incidentally recorded during stream-associated amphibian surveys in 2017. Numbers of specific taxa are summarized next to individual points.



Appendix Figure 4c. Distribution of stream-breeding amphibians incidentally recorded during stream-associated amphibian surveys in 2016. Numbers of specific taxa are summarized adjacent to either individual points or boxes encompassing groups of individual points.



Appendix Table 5. Distribution of Dunn's and Van Dyke's salamanders across the 139 unique sites sampled in the Chehalis River mainstem headwaters based on location relative to the proposed dam and reservoir (below, within or above) or elevation intervals (≤750 ft, 751-1500 ft, >1500 ft). Lower and upper 95% confidence limits indicated, respectively, as L95% and U95%.

	Dunn's Salamander					Van Dyke's Salamander				
	Sites		Statistics			Sites		Statistics		
				Confidence Limits					Confidence Limits	
Geographic Category	Present	Not Detected	Proportion	L95%	U95%	Present	Not Detected	Proportion	L95%	U95%
Position Relative to the Proposed Dam and Reservoir										
Below	7	10	0.4118	0.1844	0.6708	0	17	0.0000	0.0000	0.1951
Within	25	40	0.3846	0.2665	0.5136	1	64	0.0156	0.0004	0.0840
Above	22	35	0.3860	0.2600	0.5243	13	44	0.2281	0.1274	0.3584
Elevation Interval - feet (meters)										
≤750 ft (229 m)	30	46	0.3947	0.4975	0.7865	1	75	0.0133	0.0003	0.0271
751-1500 ft (229-457 m)	21	22	0.5116	0.3090	0.6099	7	36	0.1944	0.0819	0.3602
>1500 ft (457 m)	3	17	0.1765	0.0380	0.4343	6	14	0.4286	0.1766	0.7114